THE

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OUTSIDE WORK.

CENTRAL station engineering consists of two principal divisions—one of which deals with the central station itself, and the other with the mains and their accessories. The importance of this second division is not infrequently very much overlooked compared with the attention which the first receives.

For an engineer to become qualified to take charge of the running of a central station, a good training in mechanical engineering is generally looked upon as compulsory; and it seems quite right that this should be so, since engines and boilers are such essential features of the plant. As a rule, the course of training prescribed for those who wish to qualify for such a post is:—Three years at an engineering college, then two or three years in the workshops of a good engine builders, and, to finish up, a year or two in the works of an electrical manufacturing company. Probably it would be difficult to suggest a better course of training for the man who is to take charge of the plant—boilers, engines, and dynamos—as far as the switchboard. But, when we come to the distributing mains, another branch of knowledge is required, and to attain this the engineer's training must be in a different school. The most fitting atmosphere for the practical training of the would-be mains' superintendent seems to be that of a cable factory and its details. A pupilage spent in such a place must be of great subsequent value to anyone in charge of mains.

In connection with the appointment of a well qualified electrician to take charge of the mains, a difficulty arises at the very start. Corporations and supply companies think it is only necessary to appoint one engineer, and very often he is not engaged until the contractor's work is nearly finished. Again, it is generally experience with engines and dynamos which carries most weight in securing such a post. The mains are not fairly treated from the station's earliest days, and yet, to what a great extent does its success depend on their continually good condition. A breakdown in the mains will almost invariably mean lights out for some one, and often cause serious inconvenience and delay before the defect is localised and removed.

The mischief in many instances is brought about by the insane idea that it is economical to cut down the staff to the lowest limit, and run the station with the smallest possible number of hands. In such cases it is always the outside work which suffers most from want of proper supervision. To make matters worse, probably the lowest tender has been accepted, and the mains, with no one to look after the supply company's interest, have been badly laid from start to finish. O, ye electric light committees and the consulting engineers who pander to your foibles, how much longer will you continue to "strain at a gnat and swallow a camel?"

"It is in their joints they are weak," was a remark once made to us by one of the managers of a well known cable factory when discussing the maintenance of supply companies' mains. From the cable manufacturers only can the best jointers be obtained. As a rule, however, supply com-

panies will not pay for the services of a really first-class man, but prefer to economise (?) by employing jointers who lack thorough training, experience, and skill. A more short sighted policy than this it is difficult to imagine, and it is one which is sure to lead to disastrous results before long. But while there are central station engineers at large who have implicit belief in the efficacy of unvulcanised joints, and think that armoured cable, without suitable terminals, can with impunity be brought into street boxes; so long, the mains have not a fair chance, and the reputation of cable manufacturers is at stake.

Let us rather consider briefly what is necessary for the welfare of the mains, and what precautions supply companies must take to study their own best interests. The first step in the desired direction is to appoint a capable and suitably trained engineer to superintend all matters connected with the mains and their surroundings. He must be a man who has had some years' experience in testing, laying, and maintaining mains, and to whom the terms megohm, milliampere, and microfarad are not only so many meaningless words. He should be given a free hand in the choice of his staff of assistants, jointers, &c., and have absolute control over his department. It is his duty, in the interests of his employers, to test all their cable before it leaves the factory, to see that it reaches the required standard. This is a course at once more satisfactory to suppliers and those supplied. He must then see that the cable is properly laid, and test it when in position. To these two tests—the first, when the cable is finished in the factory; the second, when it is laid and ready for connecting to the live mains—there must be no exception. Provided the cable is of good quality and carefully put down, then the two most frequent causes of breakdowns are:—(1) Bad joints. (2) External sources, such as damage from a pick point when ground is being opened.

The first of these will be reduced to a minimum if only the most skilled and careful jointers are employed; whilst the surest safeguard against the second is vigilance on behalf of supply companies.

We believe it is no rash prophecy to predict that this branch of central station practice will, in the near future, be a subject of far greater consideration than it has been hitherto, and when this is the case, the above remarks will be more unnecessary than they are at the present time.

COMPRESSED AIR *v.* ELECTRICITY.

Air as a transmitter of power is coming into a prominent position in the United States, and its capabilities and special applications are being very warmly discussed, electrical engineers in particular attacking this resurrected power transmitter. Electrical engineers sometimes forget that electricity also is only a power transmitter. Both air and electricity start from the steam engine, waterfall, or other source of power, and are merely carriers of that power from the engine to some point where it is to be applied. In the one case the power is carried by air through pipes and valves or in a storage receiver; in the other case the power is carried through switches and wires or in a storage battery. A simple engine develops the air power, and an equally simple motor develops the electric power. These are the apparatus to be compared with each other in deciding which power transmitter is best for any given case. It is not sufficient to talk of the "economy of the electric motor"; an electric motor cannot "mote" without a prime mover, a generator, and connecting wires. The proper term is the "economy of electric transmission," or the "economy of compressed air transmission." In the battle of the systems it is not the superiority of one link in the chain of transmission which settles the contest, but the superiority of the whole from the engine to the work done.

In electric tramways, for instance, probably not more than 40 per cent. of the engine power consumed actually reaches the car axles, and this has to be compared with the losses in a compressed air car of recent construction, not with some ancient results. After that, the comparison of their maintenance cost, their suitability for city work, and general adaptability, must be made. We must confess that we have seen no attempt undertaken to tackle these points with convincing facts or figures. Believing in the superiority of electricity, it was to be hoped that some tramway experts, or experienced engineer, would take up the subject, and settle these points in a rational manner, and check the fallacies alleged to lurk in the arguments of the compressed air engineers.

The facts are: each transmitter has its own particular field of application, where it may be employed with advantage. The business of the unbiassed, intelligent engineer, is to carefully consider the conditions of every case of power transmission presented to him, and use his own experience—and that of others, when he can get it—and to exercise judgment in selecting a wheel, a rope, a belt, a shaft, compressed air, or electricity, for the carriage of the power.

Compressed air is not to be despised by electrical engineers. There are cases in which it might be a successful competitor. No less authorities than Prof. Unwin and Kennedy have, by means of scientific tests and investigations, proved that modern compressed air systems can be made tolerably economical for short distances, and extraordinarily economical for long distances.

In this country, we know of electrical transmission plants which for years have been working successfully in factories; but, still, the introduction of the electric system, after all, is surprisingly slow.

Communication between Coast and Lightships.

Apropos of the letter from Mr. Walter Riggs, which appeared in our Correspondence Column last week, we are always glad to hear of the successful working of a cable to a lightship, because it gives encouragement to the authorities responsible to persevere, and lessens the probability of the scheme being dropped. We find from the fourth and latest report of the Royal Commission, published in May, 1896, that electric communication by continuous cable was established with the *Shipwash* light vessel on November 17th, 1894, and continued in operation until August 20th, 1895, a period of 276 days—over nine months—when it parted, the cable being repaired a month later. No further interruption occurred during that year, but the outer sheathing of the electric veering cable was damaged during a heavy gale (it does not state from what quarter, presumably from the north-east) and some repairs were effected on December 2nd, 1895. This light vessel is situate at the north extreme of the Shipwash Bank in eight fathoms depth, and four miles from the nearest point of land, Orfordness. Like the *Sunk* light vessel, which is situate to the south-west of the Shipwash Bank, it is sheltered from heavy seas raised by prevailing south and south-west winds by the Kentish Knock, Longsand, and Sunk Sands, while being under the lee of the land from west and north-west winds, but it is exposed to the full effect of north-east and easterly winds. It is, therefore, satisfactory to know that cable communication has been maintained with the *Shipwash* light vessel for two years and two months, with but one interruption officially reported up to December 2nd, 1895.

ELECTRIC TRAMWAY EARTH RETURN IN BROOKLYN.

Some little while ago one of the American electrical papers (the *Electrical World*, we think) published an article describing an improvised booster or pressure raising arrangement in one of the principal electric tramway power houses of Brooklyn. According to the account therein given of the conditions that gave rise to the device (which one can only characterise as very ingenious and simple), the tramway company found its new lines across the island so extremely well patronised, that the feeders were overloaded, and terminal pressure dropped so much that the cars could hardly get along. Instead of spending time and money in elaborating a new and heavy system of feeders, the tramway management rearranged some of the power house generators to act as boosters, simply increasing the electromotive force enough to send the necessary current through at a high enough terminal pressure.

The report of the Brooklyn City Commissioners on electrical subways comes now as a fitting pendant to the article above mentioned, since it not only deals with the entire network of electric conductors in the city, whether telegraph, telephone, electric light, fire alarm, messenger service, or electric tramways—but also adds a subsidiary report to the Commission by Prof. John A. Barrett upon the electrical state of the water and gas pipe network, being practically an electrical survey of the city.

This report of Mr. Barrett's—like that of the Commission itself—offers some extremely interesting information, which, if well grounded and reliable, ought to be of service in discussing the general question of electrolysis in water or gas mains. Mr. Barrett states, in his opinion, that the rails are not sufficient for conveying the currents used back to the power house; so that subject to exceptional instances, the underground mains are receiving electricity in those sections of the city remote from the power houses, and parting with it again in districts near to power houses. That is to say, there must be currents of many thousand amperes in circuit; for the ordinary single rail of 75 lbs. section is equal at least to 1 square inch of copper. Probably, therefore, it is not merely the rails that are at fault, but the rail joints, or, in other words, the rail bonds; and Mr. Barrett's report would be still more useful if it had given results of tests upon the rail circuit as well as on the underground mains.

He gives a plan of the city, with test figures shown at the points where tests were made, and comes to the general conclusion that if a suitable and special system of return feeders were worked out and applied to the entire surface track of the city, it would be reasonable to expect a large reduction in the damage now being done to the pipes. It is an admitted fact, apparently, that improvement has taken place since investigations were last made, both by better rail bonding and the erection of return feeders.

Even when everything possible is done, however, Mr. Barrett reckons upon having at least *some* corrosion; and, in this connection, he makes a statement which merits some notice. damage

Results of his tests during 1896 show little or no [illegible] occurring to the harder type of cast-iron pipes; leads him almost to advocate their use wherever possible.

There seems to be no doubt but that a tendency to corrosion is set up even with the smallest difference of potential between pipe system and earth; the amount of current passing, and therefore the ill effects, will depend, of course, upon the earth resistance. If, however, the admitted danger of electrolysis becomes less with any particular kind or composition of metal, then the matter is fully worth a more elaborate investigation with a view to ascertain the cause and conditions.

On the face of it, the fact appears not easily explained why cast-iron should suffer so much less than lead or wrought-iron under the same conditions: where difference in electrical resistance would hardly seem to account for the discrepancies in results, such as, for example, on a branch water main with a fall of potential equal to 4 volts into the canal 40 feet distant, forming absolute earth in respect to the power house. The fall of potential between this branch main and the soil only an inch distant from the pipe was not less than ·36 volt, yet the pipe (of cast-iron) was quite uninjured throughout its length, while wrought-iron clamps and bolts, employed to fasten a cap upon the end of the pipe, had suffered seriously from corrosion. The matter is complicated by the entire absence of corrosion at joints in cast-iron pipes.

Mr. Barrett notices also in his report what does not altogether astonish us after the results already mentioned, viz., that in some places a marked difference of potential exists between the gas pipes and water mains, though such a state of affairs obviously requires early attention, since it may be found not only in the streets but in a single house!

To remedy the trouble arising from electrolysis to lead and wrought-iron service pipes, Mr. Barrett introduces seriously the question of constructing these in a fibrous non-metallic substance, so that another small field is hereby opened to the eager inventor.

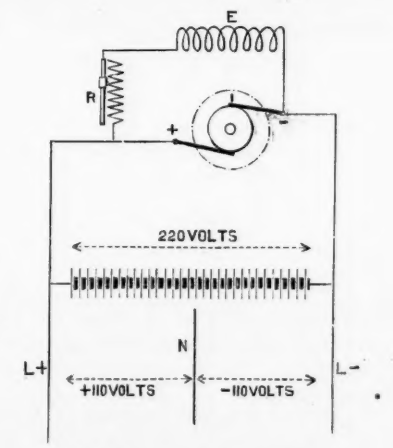
Dealing generally with the whole subject, it seems to us that here in England we are more or less able to pose upon a pedestal in that well known offensively British manner, and trot out the Board of Trade as having laid down standards of practice to be complied with by law, and of such merit as not to allow any trouble whatever of a serious nature. Privately, and when called upon to pay for an electric tramway, we perhaps swear largely and long at a grandmotherly legislation that forces us to spend great sums on feeders and general efficiency of plant; but openly we are apt to agree upon the wisdom of authority that tries to hold an even hand between counter interests—electric tramways *versus* gas and water supply.

It may be a little early to speak just yet before investigations have been made at Dublin, Coventry, Leeds, Bristol, or Walsall; but we shall be more than surprised if time shows the Board of Trade rules to be insufficient for the fair protection of underground pipes from serious corrosion as the result of electrolysis.

NEW DYNAMO FOR THREE-WIRE DISTRIBUTION.

The three-wire system of distribution has from the commencement obtained a deserved success. It allows of a considerable saving of copper in installations, and at the same time permits of the employment of the ordinary apparatus used for 110 volts.

The principal objection raised against this system of distribution is the use of groups of dynamos connected two in series. The units are thus reduced by half, which presents disadvantages universally admitted.



R, Resistance; E, Exciting circuit.

Fig. 1.

Several arrangements have been tried enabling the two sides of the three-wire system to be fed by means of a single dynamo.

One of the earliest is shown in fig. 1.

The machine of 220 volts is connected to the extremities of a battery of accumulators, the middle of which is connected with the neutral wire of the distribution.

Owing to the unequal load of the two sides, the elements work under bad conditions, and the apparatus have to allow of interchanging the elements every day.

Another method consists in covering the armatures with two distinct windings; we thus realise a dynamo having only a single inductive system; the armature is provided with two collectors connected in series (fig. 2). The objection to this method is that it is impossible to effect the regulation of the tension simultaneously on both sides, unequally loaded, since there is only one common field magnet.

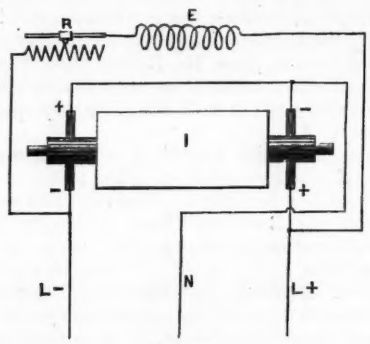
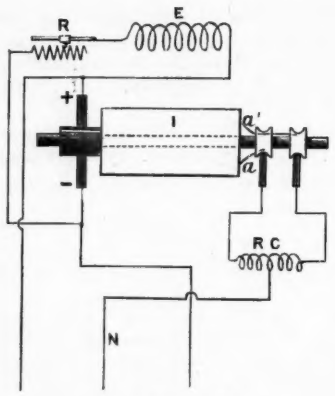


Fig. 2.

M. Dobrowolski's ingenious method has the same drawback. We know that it consists in taking for a neutral point the middle of a reactance coil, the extremities of which are connected to two sections, *a*, *a'*, diametrically opposite on the armature (fig. 3). The outer continuous current can circulate without difficulty through the reactance coil, but the latter opposes itself to the passage of the alternating current of the armature, the short-circuiting of which is thus avoided. The resistance coil, of course, consumes a little energy.



R C reactance coil.

Fig. 3.

Attempts had been made to place on an ordinary machine a third brush, equi-distant from the others, and intended to act as a neutral point, unfortunately large sparks, flashing from this intermediate brush, caused its employment to be discontinued.

M. Müller took up this idea again, several years ago, and a machine on his system was on view at the Geneva Exhibition, constructed by the Lahmeyer Company, of Frankfort.*

The inventor solved the problem completely; the intermediate brush produces no sparks, and although there is only a single armature placed in a single field magnet, the tension on the two sides can be kept constant, notwithstanding unequal charges. Figs. 4 and 5 show how these excellent results have been obtained.

An ordinary Gramme armature, wound to work with a bipolar field magnet, is mounted in a tetra-polar field magnet. The inductive coils are connected in such a manner, that the four poles really only form two. From this arrangement it follows that the poles, N S, are each divided into two, N N, S S, leaving a free space between them.

The intermediate brush is placed between the two pole pieces, N N, of the same name, and as the sections that pass under this brush are not traversed by the inductive flux, there are no sparks.

The currents in the two bridges circulate in the ordinary way, from the + brush to the − brush, passing through the outer circuit, when the charge is equally distributed. When it is unequal, a current proportionate to the difference of the charges circulates in the neutral wire and the additional brush.

Figure 5 shows the passage of the flux; the inductive flux is shown in black lines, and the armature reaction flux in dotted lines. We can see that in the electro-magnets, N_1 S_1, these fluxes are cut off, and that they are added to N_2 S_2. From this it follows that when being charged, the electro-magnets, N_1 S_1, are weakened, while the electro-magnets, N_2 S_2 are strengthened, as regards excitation. One of the sides would therefore always have a higher tension than the other whatever might be the regulation of the field of the machine.

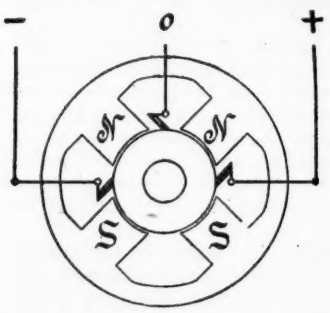


Fig. 4.

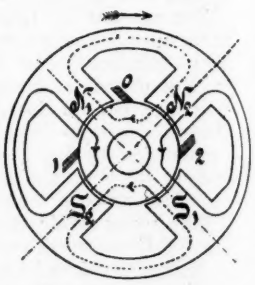


Fig. 5.

To obviate this, the electro-magnets, N_1 S_1, are mounted in series, and then connected with the terminals + and 0 (+ 110 v.) of the dynamo. It is the same with the bobbins, N_2 S_2, which are connected with the terminals 0 and − (− 110 v.). The rheostats placed in the two exciting circuits allow of the *independent* regulation of the two sides. The problem of the unequal loads is thus solved, and there is only half of the armature reaction to be compensated by a supplementary excitation.

Moreover, this mode of grouping the field magnets presents the advantage of obviating the reversals of polarity which might be produced with any other method of connection, when the side producing the antagonistic reaction at the poles, N_1 S_1, is very highly loaded, the other load being very small.

M. Müller's arrangement can be applied to multipolar dynamos; we have only to give them a number of poles double that of the field magnets required.

The machine of 75 kilowatts, tried at the Exhibition, gave excellent results; the brushes behaved very well, and the inequality in the load could be in the ratio of 1 to 2 without interfering with good working, and without preventing the maintenance of equal tensions on the two loads.

The following table shows the results of the official trial of the loading:—

Lahmeyer Machine, three wires, type G. XI.; 340 amperes, 110 volts (per side) at 500 revolutions.

Speed.	Positive side.			Negative side.		
	Volts.	Excitation amperes.	External output.	Volts.	Excitation amperes.	External output.
525 t: m.	110	5·60	0	111	3·20	0
525	110	6·60	75	110	2·80	75
500	110	8·50	155	108	2·75	155
510	110	9·60	220	110	2·65	220
500	110	12·00	340	110	2·30	340

These experiments are very interesting; they show that the excitation must be reduced with the output in the negative side, the armature reaction itself

* See Electrical Review, December 25th, 1895.

strengthening the field. In the positive side, the exciting current should be increased with the output, as is usually done with shunt dynamos. Of course, this method can be generalised, and dynamos constructed on this plan for feeding a five-wire system with a single machine. We can thus arrive at the desired employment of whole units.—M. ALIAMET (*L'Electricien*).

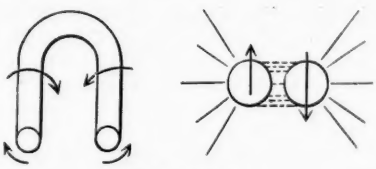
A MECHANICAL THEORY OF ELECTRICITY AND CHEMICAL ACTION.

BY ARTHUR WHITWELL, M.A., A.R.C.Sc.I.

(*Concluded from page* 64.)

If a secondary of many turns be put on the bar, a varying field, due to the primary, is fed through the secondary and an E.M.F. or turning moment, and consequently a current or rotation of molecules is set up. The increase of E.M.F. can be explained by saying that in the primary there are a number of vortex rings of rotating molecules in parallel; but in the secondary there are fewer but longer vortex rings, just as if the shorter rings were in series. Now the E.M.F's. of the primary and secondary are proportional to the turning moments of one ring in each, or practically in proportion to the lengths of primary and secondary.

Let us now consider a few electrostatic phenomena. Suppose an air-gap in an electric circuit to be so long that the E.M.F. is not sufficient to rotate the air molecules, and allow a current to pass. The ether between the ends is strained in the same way that an iron bar would be strained if it were clamped at the centre and twisted at the ends in the same direction as seen from one end of the bar. The ether will tend to contract or be screwed up, and will tend to pull the ends together, or there will be an attractive force between the two ends. One end is said to be charged negatively, and the other positively. If we place the ends side by side one will appear to have a clockwise twist and the other a counter-clockwise twist (fig. 12), hence according o



FIGS. 12 AND 13.

our theory, positive and negative charges are simply different aspects of a twisted molecule or chain of molecules. Let the E.M.F. gradually increase till the dielectric breaks down, or the resistance to rotation of the air particles is overcome (or according to the analogy till the clamp gives), the twisted chains of molecules will now rotate, and if the moment of inertia bear a definite relation to the resistance of rotation, the angular velocity will increase beyond that corresponding to the steady E.M.F., and we shall get the oscillations with which a current rises when a steady E.M.F. is impressed in a circuit. If a straight rod be placed near a conductor conveying a rising current, the varying strain fed across the rod will rotate its molecules, and when the current gets steady, the molecules in the rod will be held displaced by the strained medium. We say that the rod is charged by induction with equal amounts of + and − electricity. If the two ends are brought together the vortex rings are completed, and there will be an unbalanced pull of the ether on the molecules, due to the fact that the grip of the two ends of the circuit on the ether has been suppressed; this unbalanced tangential pull will now rotate the molecules, and an alternating current will flow till all the energy of rotation is transformed into heat.

When a conductor is charged by induction, as above described, the tangential pull of the ether all along the conductor, or the pull of the magnetic field, is balanced by the twist pull of the ether on the ends, or by the electrostatic field. If now one end of the conductor is put to earth, the electrostatic pull at that end is suppressed, the unbalanced tangential pull will rotate the chains of molecules, and a current will flow to earth. As soon as the earth connection is broken, the electrostatic pull on the end of the conductor not earthed will exceed the tangential pull, and will reverse the rotation till counterbalanced by a new pull on the other end. The conductor is now charged with the same electricity on each end, and both ends will have a clockwise or counter-clockwise twist. It follows that there must be an actual twist in the chains of molecules themselves; the amount of this latter twist will be proportional to the capacity of the conductor. By considering the process of charging a hollow sphere by induction, it will be perceived that there is no strain on the ether inside the sphere, and consequently no field of force.

In a plate glass disc frictional electrical machine, the outer portion of a molecule on the disc will move a little faster than the inner portion, and consequently the steady pressure of the rubber will give a turning moment sufficient to rotate a chain of molecules; the molecule at the end of the chain remote from the rubber will twist the ether, which will give a backward pull to balance the turning moment of the rubber, and as soon as the latter is removed the electrostatic pull of the ether will distribute itself over both ends of the chain, and a part of the disc will be charged. It is clear that a molecule on the rubber will be similarly affected, and that what is a clockwise twist on the disc will be a counter-clockwise twist on the rubber; hence, if the disc is charged positively, the rubber will be charged negatively.

Leaving electrostatics, let us endeavour to explain some thermo-electric phenomena. Consider an imaginary plane section of a rod of copper. A molecule in this section half at one side and half at the other, will be subjected to a certain number of collisions at each side of the section, the net result being that its rotation about an axis at right angles to the section will be zero, that is to say, the turning couples due to the collisions at each side will, in the main, balance one another. Now suppose the material on one side of the imaginary section be changed into lead; it will not be difficult to conceive that, owing to the difference of the number of collisions, or to the difference of structure and arrangement of molecules in the two materials, the collisions on the molecule in the imaginary section may result in producing a turning couple in one direction or the other, and consequently a momentary rotation of a chain of molecules and an electrostatic field to balance the couple. This is a possible explanation of an E.M.F. set up by mere contact of two metals. If a ring be formed half of copper and half of lead, it is natural to suppose that turning couples on molecules at one junction would be balanced by opposite couples at the other junction, so that there would be no resultant current, but if one junction be heated, the increase of the linear velocity of the molecules and the increase in the number of collisions would upset the balance and result in a current.

In order to explain the generation of an electric current by chemical action, it is necessary to form some further conception respecting atoms and molecules. Hitherto we have only spoken of molecules. We know that a molecule is made up of two or more atoms, and that molecules of elementary substances can exchange atoms and form chemical compounds. A molecule of hydrogen can exchange one of its two atoms for one of the two atoms of a molecule of chlorine, the result being two molecules of hydrochloric acid. This exchange of atoms is generally accompanied by the production of heat. The molecules of H, Cl, and H Cl, have definite amounts of energy, but one molecule of H and one of Cl have more energy than two molecules of H Cl.

Now how can molecules store up energy? Let two atoms, rotating in different directions, come together, as shown in fig. 13; they will strain the ether between them as if it were a piece of elastic, just as in that penny toy lately sold in the Strand, in which two wooden balls connected by India-rubber strings performed some curious antics. If we suppose the atoms to be rough, when they are screwed up tight they will stick or interlock, thus producing a two-atom molecule, possessing stored up energy, the potential energy being due to the strained ether, which tends to untwist and rotate the molecules in the opposite directions to which they were twisted together. In fact, according to our notions, the molecules are charged with + or − electricity, according as the strain in the ether is clockwise or the reverse.

If a number of molecules of H and Cl are put together in a receiver at a low temperature, they will mix and collide, but no decomposition will occur; if the temperature be raised sufficiently to make the collisions smart enough to unlock the atoms, they will lose one another, and the strained ether will cause them to rotate in the opposite direction to that in which they were wound up. The rotation of the atoms will be partially converted by collisions into increased linear velocity or the temperature will be raised. Nascent atoms, or recently released atoms of H and Cl coming together, will strain the ether between them, and wind themselves up into new molecules of H Cl possessing less energy than the separate atoms possessed before decomposition. A spark, or small current sent through the gas, will supply the twist necessary to unlock the atoms and set them free. An electric spark, then, will facilitate chemical combination at a low temperature. The phenomenon of dissociation can be accounted for in this way—at a certain temperature the atoms of a substance, which has four atoms to a molecule, say, will untwist, and either twist up again in fours or in two's.

The generation of an electric current by chemical means can be explained with the assistance of this idea of composite molecules possessing electric charges and energy as follows:—We will take a simple cell with Zn and Cu rods immersed in water containing a few molecules of $H_2 SO_4$. The contact of the $H_2 SO_4$ with the Cu and Zn will produce a twist sufficient to unlock the molecules, as suggested above, in dealing with the E.M.F. produced by simple contact. The SO_4 part of one molecule of $H_2 SO_4$, and the hydrogen part

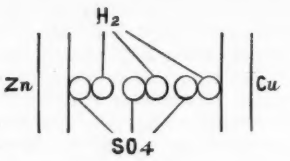


Fig. 14.

of the adjacent one (fig. 14), both being in the nascent state, will wind up the ether between them till they lock together to form a new molecule of $H_2 SO_4$. This action will go on in the whole chain. The SO_4 part of a molecule next to the Zn will seize an atom of Zn and wind it up to form a molecule of $Zn SO_4$. The pairs of hydrogen atoms at the other ends of the chains may be assumed to be already twisted together, forming molecules of hydrogen complete before being twisted up to their SO_4 parts. The molecules of $Zn SO_4$ have less energy than their constituents, hence energy is liberated. Some of the energy is used up as heat, and some in producing a current which generates heat in the circuit.

When the two parts of the $H_2 SO_4$ molecules are unlocked and set free, they will rotate in opposite directions and tend to send currents in opposite directions, but being of different masses their angular velocities will be different, and there will be a resultant angular velocity or current. This explanation will apply to the reverse phenomenon of electrolysis, in which a current decomposes an electrolyte and stores up energy in the products, the energy of the current being partly used in heat and partly stored up as in a condenser. This explanation of electrolysis and the "migration of ions" is admittedly crude, and requires careful thought to develop it properly, and my only object in touching on it is to show that the fundamental idea expressed in this article is capable of explaining chemical phenomena as it should be, if it is to be regarded as true.

The electro-optical experiments of Faraday and Kerr are readily explained. If plane polarised light is sent through a solenoid its plane of polarisation is rotated. Consider a molecule moving in a straight line in a plane perpendicular to the axis of the solenoid. Owing to the longitudinal and radial changes of ether density, it will have two rotations at right angles, and the resultant rotation will produce a force tending to move the molecule out of its line of motion. It is immaterial whether the molecule is supposed to be transmitting motion to the next one above it or the next one below it; in other words, the direction of rotation of the plane of polarisation is independent of the direction of propagation of the light.

If plane polarised light be reflected from the magnet, fig. 8, and a molecule is moving at an angle to any of the arrows, it is evident that the direction of motion of the molecule will be changed or the plane of polarisation rotated.

If we consider the sun as a huge molecule, we see that its rotation will cause it to strain the ether and produce a magnetic and electrostatic field. A planet whirled off at a tangent will have all its molecules rotated since they would be subjected to a difference of pressure as in fig. 1. Some of the molecules will form complete rings, and if of magnetic substances it is conceivable that these rings, see fig. 8, will make the planet a huge magnet. The twist of the ether produced by the ends of rotating molecular chains would result in an electrostatic pull, and when the work done against this pull is equal to the $\frac{1}{2} m v^2$ of the planet its linear motion would cease and its revolution commence. Gravitation then would be an electrostatic phenomenon on an enormous scale.

Atmospheric electricity in this hypothesis is due to the molecules of clouds being rotated by motion in the earth's magnetic field.

In conclusion, it may be perhaps permissible for me to point out that, up to the present, there has been propounded no intelligible hypothesis that accounts simultaneously for such diverse phenomena as those of magnetism, static and current electricity, electro-magnetism, hysteresis, electrolysis, and chemical combination; and it may also be permissible for me to claim that in this mechanical theory of electricity, based on the idea of rotating molecules, will be found as true an answer to the question, What is electricity? as is supplied by the mechanical theory of heat to the question, What is heat? However this may be, the idea of molecular rotation, applied as it is in this paper, at least brings together and co-ordinates a mass of physical facts never before properly connected by one fundamental idea.

AMAZON CABLE.

In our "City Notes" of July 12th, 1895, we had occasion, on the formation of the Amazon Telegraph Company, Limited, to state our belief that the maintenance of a cable laid along a river of such a length and magnitude might be considerable and difficult, and it was questioned if £4,000, the sum agreed upon to be set aside yearly as a reserve fund for repairs and renewals, was sufficient. Events so far have unfortunately confirmed our opinion. The cables along the Amazon were laid and opened on February 12th, 1896. There are no insuperable difficulties in laying a cable, but experience has taught those having a knowledge of tropical river work that the existence of a mud bottom, said to have been found on the upper reaches when sounding, should not have been accepted as a place in which to lay the cable until it had been ascertained that the mud would stay there any length of time. The first difficulty reported was the interruption of the cable between Santarem and Manaos on March 27th, 1896, but this lasted only one day. However, on May 5th, three months after the opening of the cable for traffic, the section beyond Monte Alegre was declared interrupted, and there has been no communication with Manaos since that date, although we are informed the cable is up as far as Itacatiara. It will thus be seen that the trouble first commenced at the mouth of the Tapajos and it extends, so far as we know, to Itacatiara at the mouth of the Madeira. Between Santarem and Itacatiara are other rivers and all are of some magnitude, continually—and especially so during the flood times when the rise of water is abnormal—discharging vast volumes of water, mud, and *débris* of all kind into the main river, Amazon. As a natural consequence, and especially near the mouths of the tributary rivers, scouring and deposit must be abnormally great, and the latter is so rapid that, as in other tropical rivers it must almost be possible to watch the growth of islands which, before they have got to any size, may be swept away again.

Consequently it is probable that a cable laid in any river in a tropical region may, at such shallow places, be uncovered and subject to a continual grinding and pounding by snags,

while at a very short distance, clear of the islands and eddies, it is being covered up beyond recovery. These conditions, if they cannot be escaped, must always be inimical to the life of a cable, and it is a question had the survey been extended over at least a whole year, during which time the effects of the various seasons could have been watched, if all difficulties could have been avoided. It is possible the bed of the river is always altering and it seems to us problematical to-day if after a series of repairs a bed will be found which will remain unaltered in formation for any great length of time. On the other hand the Pará River cable of a heavier type has been laid since 1873, and is now working. To a less extent we think it must be subject to somewhat the same conditions as the cable on the upper reaches, but it has had a long life.

The sum set aside for repairs will not, we fear, cover the outlay on this account for some time to come, and until the proper bed for the cable has been found. We hope this may be done speedily, and also that the great efforts made by the company to effect repairs will eliminate the abnormal expense which they must incur. There remains also to be seen how far the calculations of a revenue from traffic of £36,250 will be justified. Providing it is found to be correct, the working expenses and amortisation fund will absorb £21,000, and there would be left a balance of, say, £32,000 (including the subsidy of £17,000, if it does not lapse on a time limit of interruption) to meet interest on a capital of £250,000, of which £211,000 was expended on concessions, making and laying the cable, &c., &c., and calls on account of a reserve fund, including repairs and renewals. It was, however, stated by the chairman of the company at the second ordinary general meeting that the first 4½ months' traffic resulted in a return of £5,224, but as the cables were working throughout the whole length for only about three months, it would appear that the yearly traffic would work out at about £21,000 or £15,000 less than the receipts estimated before the opening of the cable. At this 28 per cent. reduction the total estimated income of £53,000 would only be £38,000, and allowing £21,000 for working expenses and amortisation, there would remain £17,000 for interest and repairs, and this will only allow of a return of 5 per cent. on the capital as against the estimated 10 per cent., if £4,500 is taken for repairs and renewals.

REVIEWS.

Manual of Electrical Undertakings, 1896. By EMILE GARCKE. London: P. S. King & Son. Price 5s.

If we were to paraphrase and slightly alter the remarks of the author on this work, we should say that little or no excuse is needed for a manual which it is proposed to publish annually, containing financial particulars of an industry in which already upwards of fifty millions of capital are invested and which promises to assume a still larger proportion. The book is simply a collection of accounts and other particulars of electrical undertakings arranged under the headings of Telegraph, Telephone, Electricity Supply, Traction, Manufacturing, &c. The author does not attempt to analyse the accounts in any way, he simply presents them in a convenient shape and leaves the reader to form his own conclusions. To one interested in the electrical industry, and it is mainly for those that the book is intended, the reading is not dry; indeed, there are one or two chapters which, if not exciting, are of profound interest, we refer to the details relating to traction and the electrical companies registered in each year since 1856. The value of this book will grow from year to year, and no establishment that is associated with the electrical industry will be complete in its literature without a copy.

Tramway Motors: Lessons from America. Glasgow: George Outram & Co., *Herald* Office.

This work is composed of matter that originally appeared in the *Glasgow Herald*, and is the result of an independent enquiry made in America by a member of the *Glasgow Herald* staff. There is very little doubt that the enterprise of our daily contemporary has resulted in the collection of electrical data which are of importance at the present moment. The inquiries of the roving commissioner must have been conducted with considerable skill, for he has contrived to elicit all the essential points of tramway working in the various towns of the United States. The conclusions of the writer point unmistakably to the overhead system of electric traction, although he fully admits the advantages of the cable system. Members of town councils who are anxious to learn something of the commercial working of tramways, cannot do better than consult this most useful little book.

The Tutorial Chemistry. Part I., Non-Metals. By G. H. BAILEY, D.Sc., London. Edited by W. Briggs, M.A. London: W. B. Clive, University Correspondence College Press, 13, Booksellers Row, Strand, W.C.

A well arranged book but possessing few features of novelty, this work may safely be used by students. It is somewhat unfortunate, however, that the opening chapter should inspire grave misgivings as to the carefulness with which the book has been written, we refer particularly to the series of questions given at the end of the chapter. Question 1 is "What is limestone and how is it converted into lime?" Question 9 "What elements form the essential constituents of (*a*) limestone, (*b*) sandstone, (*c*) water, (*d*) air?" Now there is not one word about limestone, sandstone, or air in the chapter. Such an instance of carelessness, as we said, is liable to inspire grave misgivings; we have not, however, been able to detect such want of care in any other part of the work. On page 22, however, we observe a note which is liable to mislead, if it is not distinctly incorrect; referring to the decomposition of "water" by the electric current in a voltameter, and explaining that it is necessary to add sulphuric acid to the water in order to make the latter conduct, it is stated, "we may regard the decomposition as being that of dilute sulphuric acid." Now inasmuch as sulphuric acid is composed of other elements than oxygen and hydrogen (the products of decomposition which collect in the voltameter), the sulphuric acid cannot be said to play any other part than that of making the liquid a conductor.

The Mechanical World Pocket Diary for 1897. Tenth year of publication. Manchester: Emmott & Co., Limited, New Bridge Street.

The 10th annual issue of this publication contains additional matter to the extent, it is stated, of 40 pages. The principal changes relate to the "Testing of Gas Engines." "Incrustation and Corrosion in Steam Boilers," "Notes on Annealing, Hardening, and Tempering," "Power required to drive Machine Tools." The book is certainly well worth its price (6d.)

Lockwood Builders' Price Book.

Messrs. Crosby Lockwood & Co. have just issued the 1897 edition of this annual with such revision of prices as resulted from the general advance in wages which was conceded by the masters as a result of the strike that took place in the summer. The editor predicts a busy year and a general rise in prices of material. The book includes an extensive section dealing with electric lighting, arranged by Mr. A. P. Haslam, A.I.E.E.

ELECTRIC RAILWAY POWER STATIONS IN AMERICA AND THE ECONOMIC RESULTS OF THEIR OPERATION.*

By L. D. TANDY.

THE question of expenses and economies in the production of electric power is naturally one of vast interest to readers of the *Street Railway Journal*, and one that has justly claimed a large share of thought and attention. It hardly seems necessary, therefore, for me to enlarge upon the difficulty experienced in obtaining comparable data, owing to the variety of methods practised by different roads in keeping their records.

* *Street Railway Journal.*

The first question to be decided in providing for the construction of a road, is: "What kind of a power station is the most suitable for the conditions under which the railway has to operate, and which is the most economical?" There are six kinds of stations; namely, the expensive, moderate, and cheap *theoretical* stations, and the expensive, moderate, and cheap *practical* stations. If the owner of the proposed line is not a man overburdened with theories, he naturally directs his attention to the last three, and confines his investigations thereto.

In Table I. will be found in detail the operation of a number of stations of various types, including the triple-expansion and compound (cross and tandem) engines, direct connected and belt-driven generators, condensing and non-condensing.

Stations A, B, C and E are large stations, containing the most expensive machinery. No expense has been spared in their construction, and, in consequence, fixed charges are exceedingly high. These stations have a normal load as compared with their rated capacity, and are comparable with any of the large metropolitan stations.

In station A, I would call special attention to the figures relating to evaporation, wherein the water per pound of coal is shown to be below normal; namely, 7·6 lbs., while the coal per kilowatt hour is also very low. The results obtained at this station are remarkable, inasmuch as the consumption of water is less than 15 lbs. per H.P. hour; a record which many claim to make, but few achieve, and this is not indicated horse-power, but an electric horse-power at the switchboard, which includes engine and generator losses. It would appear from this, therefore, that mistakes are made in many stations in crowding the boilers to evaporate too much water per pound of coal, paying but little attention to the quality of steam produced from so high an evaporation. If, in the designing of a station, a trifle more leeway in the boiler room were allowed, it would tend materially towards reducing the cost of producing power. It is also interesting to calculate the thermal units in our coal; assuming a theoretical efficiency of 10 per cent., taking 778 foot-pounds equal to 1 thermal unit, we find we are obtaining 13,000 thermal units per pound from our coal. This, to say the least, is startling, as this figure is about the maximum of the best Cumberland or Clear Creek bituminous coal, while the coal at the station under observation is anthracite buckwheat, and the horse-power, or kilowatt hour taken at the switchboard and not an indicated horse-power.

Station B is, if anything, overloaded, and consequently the results obtained therefrom are more favourable than those arrived at in connection with stations A, C and E.

Station D is a representative city station of moderate cost and high efficiency.

Stations F, G and H are city stations of moderate cost. They are not of absolutely modern construction, but at the time of their erection, were as perfect as money could make them.

Station I is a model station, of small size, running an extremely variable load.

Station J is a large city station running under adverse conditions, having been designed as a condensing station; but owing to difficulty in connection with condensing water, it was operating non-condensing. The load here is also very variable. The same criticisms will apply (perhaps with greater force) to this station as to stations A, B, C and E.

Owing to lack of time in which to satisfactorily prepare it for publication, I am unable to submit data of a representative simple, non-condensing station. This I regret, in view of the fact that the cheapest power produced in the United States, to my knowledge, is in a station of this type. The average cost for a period of one year was $·0058 per kilowatt-hour. This station is equipped with single cylinder non-condensing engines, 34-inch × 60-inch cylinders, large units, fire tube boilers, and steam pressure at 110 lbs. The cost for the construction of this station, per kilowatt, was less than for any station of its kind in the United States.

It is, of course, an undisputed fact that there are no two stations operating under exactly similar conditions, and the figures which are submitted for the purpose of making as close a general comparison as possible.

(To be continued.)

Table I.

Station.	Boilers.	Pressure.	Style of engines.	Cond. or non-cond.	Style of generators.	Coal.	Cost of coal per net ton.	Lbs. coal per kw. hour.	Lbs. water per lb. coal.	Lbs. water per kw. hour.	Cost per kilowatt hour.						
											Cost of coal.	Operating supplies, excl. of coal.	Labour operation.	Supplies maintenance.	Labour maintenance.	Maintenance buildings.	Total.
"A"	W.T.	160	Cross Comp.	C	Direct	Anth.	$2·40	2·6	7·6	19·9	$·0028	$·0005	$·0024	$·0003	$·0001	$·0001	$·0061
"B"	„	160	Trip. Exp'n.	C	Belt	Bit.	3·50	3·5	9·8	34·	·0052	·0008	·0023	·0006	·0005	·0002	·0096
"C"	„	160	Cross Comp.	C	Belt	Anth.	2·40	3·11	7·7	24·1	·0033	·0008	·0044	·0002	·0005	·0001	·0093
"D"	„	160	Tand. Comp.	N C	Belt	Anth.	3·15	3·65	9·3	33·8	·0051	·0009	·0030	·0001	·0001	...	·0092
"E"	„	160	Cross Comp.	C	Belt	Anth.	2·07	3·5	8·	31·	·0033	·0010	·0043	·0003	·0006	·0001	·0096
"F"	„	140	Cross Comp.	C	Belt	Cumb. Bit.	2·90	3·8	9·3	35·3	·0056	...	...	...	...	...	·0100
"G"	„	140	Cross Comp.	C	Belt	Cumb. Bit.	3·23	4·	9·4	37·6	·0065	...	...	...	...	...	·0109
"H"	„	150	Cross Comp.	C	Belt	Cumb. Bit.	3·05	4·4	8·5	37·4	·0068	...	...	...	...	...	·0112
"I"	„	150	Tand. Comp.	C	Direct	Cumb. Bit.	2·69	4·2	...	...	·0050	·0006	·0042	·0002	·0004	·0001	·0105
"J"	„	160	Vert. Comp.	N C	Direct	Bit. Scrn'g.	1·40	6·2	6·9	41·3	·0057	·0004	·0033	·0004	·0001	...	·0098

THE CITY AND GUILDS OF LONDON INSTITUTE.

The report of the Special Committee on this Institution, which has recently been issued, is to some extent a surprise, as the necessity for answering a solitary anonymous communication is not usually recognised. It would look almost as if some more serious reflections had been made at various times upon the conduct of the Institution, and that the anonymous publication in question were made a pretext for more fully advocating its claims. A really flourishing concern could surely have afforded to ignore the statement made in a pamphlet which, from its being nameless, should have been wholly disregarded. However, a committee has thought fit to make a full report, and the latter is certainly interesting reading. The report is, perhaps, not so exhaustive as it might have been, and it lacks force from the fact that all the evidence is one-sided; one would have liked to have heard in what respects the Institution is lacking; it can hardly be that it is altogether perfect, as the statements seem to indicate. At the same time, we quite think that the

Institution has little to fear from outside criticism, as there is plenty to show that it is worthy to rank in efficiency, if not in size or endowment, with any in the world.

The general result of the investigation shows that the gross cost per student per annum is £54, as against £59 for the Zurich Polytechnic, and £60 to £63 for American institutions. Cost per student is, however, by no means necessarily an indication of efficiency; indeed, it would be extremely difficult to standardise the latter. Referring to the second report of the Royal Commission of 1884, it is stated that "in the Polytechnics of Germany there is accommodation for about 6,000 students, whilst the total attendance is little more than 2,000." Since that period the accommodation has greatly increased, and at Charlottenburg (Berlin) alone there are over 2,000 students. It is evident from this that Germany is making great strides in technical education as regards actual accommodation, but whether this is taken full advantage of, or whether the accommodation is overdone, does not appear. The City Guilds report does not indicate what proportion the attendance bears to the accommodation at the Institute, and, consequently, the fact that the dimensions of the buildings in this country are much less than on the Continent does not indicate that we are behindhand.

The general conclusion of the Committee is that "the work of the College has been eminently successful," a conclusion which, we believe, to be quite a correct one, and such statements as "the deplorable condition of affairs connected with the Central College," which the anonymous pamphlet contains, only deserve to be laughed at as a piece of childish spleen.

The report on German competition and education, by Sir Philip Magnus, Mr. C. R. Redgrave, Mr. Savill Smith, and Mr. W. Woodall, which has just been issued as a Parliamentary paper, has a direct bearing upon the value of the Technical Institute, and the necessity of not only maintaining it in as high a state of efficiency as possible, but of largely extending its field of operations. It is extremely doubtful if the nation is properly alive to the risk it runs by not pushing forward with all possible speed the formation of well-equipped technical institutes. "The Germans," says the report, "appear now to attach greater importance than ever to the connection between such higher scientific training and the development of manufacturing industry. No nation not overburdened with capital would continue to erect and equip institutions for advanced instruction and scientific research without a firm conviction of their industrial value. The demand, too, for such higher teaching seems to increase as the facilities for providing it are enlarged. For, whereas in 1884 we stated that the total attendance at the Polytechnicums was little more than 2,000, the attendance of students at Charlottenburg alone, irrespective of the Berlin University, is now 3,000, while the number of students in the physical and electro-technical laboratories at Darmstadt is already in excess of the accommodation, and the buildings, which were only completed in October, 1895, are now undergoing extension."

As regards electrical technology, the Commissioners say: "Twelve years ago there was no laboratory in Germany for instruction in electrical technology equal to that at the Finsbury Technical College. Now there are none in England which can be compared to those at Berlin, Darmstadt, Stuttgart, and at Hanover." The backwardness of this country is undoubtedly due to the fact that the value of a scientifically trained staff is not yet recognised by men of business in England; also, the latter too often think they know better than their customers what is required, or in other words, will not go out of their way to suit their customers. The very lukewarm, nay, cold, attitude of the State in regard to scientific help by money grants, is also a large factor.

BRITISH MOTOR SYNDICATE.

Fancy one solitary cotton mill being sufficient to accommodate the Daimler Company, the Great Horseless Carriage Company, and the Beeston Tyre Company, as well as the Three Millions Capital British Motor Syndicate. But fancy the effrontery which even invites shareholders to meet at the old mill, much as though they were a little private company of £10,000 or so capital, who had been able to buy an old disused mill for £3,000. We have seen old cotton mills full of new machinery and new boilers go for little more. Yet this is what Mr. Lawson has done, and if the public, or any section of them, are stupid enough to find him capital, we feel inclined to think they deserve to lose it. Mr. Lawson is not complimentary to engineers. According to him no engineer in England understands motor cars. Mr. Lawson has found that the engineers of England know the difference between a genuine motor car and a financial spec., and has, therefore, no opinion of engineers, and so he went on detailing how two of his old flotations had fallen in the market and subsequently risen again; but as one of the financial papers remarks, he said nothing of some five other rank failures. For days, says a prominent broker, the price of the £3 stuff of the Motor Syndicate has not touched 25s., and Mr. Lawson plumes himself on their being worth more than £1. Now, if a £3 share is not to be worth more than a £1, why should £3 have been given for it. Yet this sort of claptrap went down with the shareholders who were apparently satisfied that they had bought an old cotton mill and a few tools for £3,000,000, for, after all, what else have they got? Certainly, no patents that are of any high value. They possess no motor better than competitors can put on the market for a tenth the capital of the notorious syndicate. Mr. Lawson has, doubtless, his own ideas of good taste, and probably he acted upon them when he invoked the Deity to assist him in pulling the motor through. Mr. Lawson should be careful lest the power he invokes place him where gasolene motors at least will be ruled off as having too low a flashing point.

Flatulent vanity is the *Financial Times'* verdict on Mr. Lawson's speech at Coventry, which contains no information, but was simply as the crackling of thorns under the pot, which simple shareholders mistook for solid fuel.

IMPORT DUTIES IN FOREIGN COUNTRIES ON DYNAMO-ELECTRIC MACHINERY AND ELECTRIC LAMPS.*

The following statement, showing the rates of import duty leviable on dynamo-electric machinery and electric lamps in the principal European countries and India, has recently been prepared by the Board of Trade:—

Countries and tariff classification.	Rates of duty.	English equivalents.
Austria-Hungary—	Fl. Kr.	£ s. d.
Dynamo-electric machines	100 kilos. 5 00	Cwt. 0 5 1
Electric lamps	„ 50 00	„ 2 10 10
Belgium—		
Dynamo-electric machinery: The duties are assimilated to those on machines and machinery of all kinds which are—	Frs. cts.	
Machinery of cast-iron	100 kilos. 2 00	Cwt. 0 0 9¾
Machinery of wrought iron or steel ...	„ 4 00	„ 0 1 7½
Machinery of copper or other metal ...	„ 12 00	„ 0 4 10½
Electric lamps	10 % *ad val.*	10 % *ad val.*
Bulgaria	10½ % *ad val.*	10½ % *ad val.*
Denmark—	Kron. Ore	
Dynamo-electric machines	Pund† 0 02½	Cwt. 0 2 4
Electric lamps	According to material of which composed.	
France—		
Dynamo-electric machines weighing—		
5,000 kilos. and more, containing at least 50 % of cast iron	Frs. cts. 100 kilos. 12 00	Cwt. 0 4 10½
5,000 kilos. and more containing less than 50 % of cast iron	„ 20 00	„ 0 8 2
From 2,000 to 5,000 kilos containing at least 50% of cast-iron	„ 18 00	„ 0 7 4
From 2,000 to 5,000 kilos. containing less than 50% of cast-iron ...	„ 20 00	„ 0 8 2
From 1,000 to 2,000 kilos.	„ 20 00	„ 0 8 2
From 50 to 1,000 kilos.	„ 30 00	„ 0 12 2
From 10 to 50 kilos. ...	„ 80 00	„ 1 12 6
Conductors for dynamo-electric machines and detached pieces, such as metal coils, surrounded by insulated copper, worked parts of copper weighing less than 1 kilo., numbered and marked, fitted together or not for electric machines weighing—		
More than 2,000 kilos.	„ 35 00	„ 0 14 3
From 1,000 to 2,000 ks.	„ 40 00	„ 0 16 3
From 200 to 1,000 kilos.	„ 45 00	„ 0 18 3
From 1 to 200 kilos. ...	„ 60 00	„ 1 4 5
Less than 1 kilo. ...	„ 75 00	„ 1 10 6

* *Board of Trade Journal.*

† Or 10 % *ad val.* at option of importer.

Countries and tariff classification.	Rates of duty.	English equivalents.
FRANCE—*continued.*		
Electric lamps—		
Incandescent lamps of glass—	Frs. cts.	£ s. d.
With their mountings ...	100 kilos. 350 00	Cwt. 7 2 3
Not with mountings ...	„ 700 00	„ 14 4 6
Arc lamps (regulators) ...	„ 60 00	„ 1 4 5
GERMANY—		
Dynamo-electric machines (so far as they cannot be described as "Lokomotiven" or "Lokomobilen")		
Preponderating material being of cast-iron ...	Mks. pfs. „ 3 00	„ 0 1 6½
Do. do., wrought-iron ...	„ 5 00	„ 0 2 6½
Do. do., of other common metal	„ 8 00	„ 0 4 0¾
Electric lamps—		
Incandescent (*Gluh*) lamps of glass in conjunction with other materials so far as the same cannot be classed as hardwares, &c., with the exception of cases in which platinum wire is used	„ 24 00	„ 0 12 2
Electric arc ("Bogen") lamps and other electric lamps	According to material of which composed.	
GREECE—		
Dynamo-electric machines	Free.	Free.
Electric lamps—	Dr. 1.	
If of glass	Oke 1 00	Cwt. 1 12 0
If of plain porcelain ...	100 Okes 50 00	„ 0 16 0
If of porcelain, inlaid coloured or gilt	„ 200 00	„ 3 4 0
All others	According to material of which made.	
HOLLAND—		
Dynamo-electric machinery	Free.	Free.
Electric lamps and appliances for electric lighting not forming part of the machinery	5 % *ad val.*	5 % *ad val.*
ITALY—		
Dynamo-electric machines—	Lire cts.	
Weighing up to 1,000 ks.	100 kilos. 25 00	Cwt. 0 10 2
Do., more than 1,000 ks.	„ 16 00	„ 0 6 6
Detached parts of dynamo-electric machines ...	„ 25 00	„ 0 10 2
Electric lamps of bronze, brass, steel, or iron ...	„ 30 00	„ 0 12 2
Do., do., of other materials	According to material of which made.	
NORWAY—		
Dynamo-electric machinery	Free.	Free.
Electric lamps	According to material of which chiefly made.	
PORTUGAL—		
Electric apparatus and machinery for whatever purpose	30 % *ad val.*	30 % *ad val.*
Electric lamps	According to material of which made.	
ROUMANIA—	Lei. b.	
Dynamo-electric machines	Free.	Free.
Electric lamps	100 kilos. 50 00	Cwt. 1 0 4
RUSSIA—		
Dynamo-electric machines of all kinds	Rbls. cop. Poud 1 40	„ 0 13 9
Electric lamps	„ 6 00	„ 2 19 1
SPAIN—	Pes. cts.	
Dynamo-electric machines	100 kilos. 18 50	Cwt. 0 7 6
Electric lamps: chargeable as ordinary lamps according to material of which composed, as follows:—		
Of copper	„ 125 00	„ 2 10 0
„ cast-iron	„ 8 50 to 17 50	„ 0 3 5½ to 0 7 1½
„ wrought-iron ...	„ 25 00 to 36 00	„ 0 10 2 to 0 14 8
„ tin-plate	„ 50 00	„ 1 0 4
„ other common metals	„ 37 50 to 45 00	„ 0 15 3 to 0 18 3
„ glass and crystal ...	„ 50 00 to 110 00	„ 1 0 4 to 2 4 9
„ earthenware ...	„ 37 50 to 120 00	„ 0 15 3 to 2 8 9
„ porcelain	„ 52 50 to 120 00	„ 1 1 4 to 2 8 9
SWEDEN—	Kron. öre.	
Dynamo-electric machinery	10 % *ad val.*	10 % *ad val.*
Electric lamps	Kilog. 1 50	Cwt. 4 4 8

Countries and tariff classification.	Rates of duty.	English equivalents.
SWITZERLAND—	Frs. crs.	£ s. d.
Dynamo-electric machines	100 kilos. 4 00	Cwt. 0 1 7½
Electric lamps	„ 6 00	„ 0 2 5¼
TURKEY—	8 % *ad val.*	8 % *ad val.*
UNITED STATES—		
Dynamo-electric machines	35 % *ad val.*	35 % *ad val.*
Electric lamps, of metal ...	35 % *ad val.*	35 % *ad val.*
„ „ of glass ...	35 % *ad val.*	35 % *ad val.*

INDIA.

	Rate of duty.
Machinery, namely, prime movers and component parts thereof, including boilers and component parts thereof; also including locomotive and portable engines, steam rollers, fire engines, and other machines in which the prime mover is not separable from the operative parts Machinery (and component parts thereof), meaning machines or sets of machines to be worked by electric, steam, water, fire, or other power not being manual or animal labour, or which before being brought into use require to be fixed with reference to other moving parts, and which are intended for:— (*a*) The preparing, ginning, pressing, spinning, weaving, sewing, knitting, bleaching, and dyeing of cotton, jute, hemp, silk, wool, or other fibres, and any other process intervening between the raw material and the finished product as packed ready for the market. (*b*) The smelting and milling of iron and other metallic ores and the manufacture of iron, steel, and other metals. (*c*) The manufacture of leather, sugar, indigo, silk, paper, soap, gas, oil, flour, cordage, rope, and twine. (*d*) The milling of rice. (*e*) The manufacture of tea in all its stages, from the drying of the leaf to its packing for the market, inclusive. (*f*) The pulping of coffee. (*g*) Printing presses. (*h*) Foundries and workshops of iron and other metals. (*i*) Railway workshops. (*j*) The refining of petroleum, and the manufacture of vegetable oils. (*k*) The crushing of bones and bricks. (*l*) The manufacture of lac. (*m*) Potteries. (*n*) Sawmills. (*o*) Agriculture, mining, navigation, dredging, and pumping. (*p*) Such other manufactures and industries as the Governor-General in Council may from time to time specify. Provided that the term does not include tools and implements to be worked by manual or animal labour, and provided also that only such articles shall be admitted as component parts of machinery as are indispensable for the working of the machinery, and are, owing to their shape or to other special quality, not adapted for any other purpose. *Note.*—Machinery and component parts thereof made of substances other than metal are included in this entry.	Free.
Machinery and component parts thereof not included in the foregoing exemptions	5 % *ad val.*

LEGAL.

WEDEKIND *v.* GENERAL ELECTRIC COMPANY, LIMITED.

ALLEGED INFRINGEMENT OF RECEIVER AND TRANSMITTER DESIGN.

In the Queen's Bench Division of the High Courts, on Monday, Mr. Justice Charles commenced the hearing of an action by Julius Edward Wedekind against the General Electric Company, Limited. The plaintiff claimed for damages for alleged infringement of the plaintiff's registered design, or alternatively for an account of the proceeds of sale of all articles made in infringement of the said design; for delivery up of all articles in the possession of the defendants, their servants and agents, made in infringement of the design; an injunction to restrain the defendants from further infringements; and costs. Mr. Lewis Edmunds, Q.C., and Mr. Walter H. Moresby were for the plaintiff; and Mr. McCall, Q.C., and Mr. Charles C. Scott for the defendant company.

The case for the plaintiff was that he is the owner and registered proprietor of a design for a telephone transmitter and receiver. The design was registered on September 28th, 1892, in Class 1, its number being 199,593. It was registered by its authors, George Lee Anders and Walter Kottgen; and it was duly assigned by them to the plaintiff on March 7th, 1896. Plaintiff alleges that the defendants, since the date of the registration of the design, had wrongfully applied it, or a fraudulent or obvious imitation of it, to goods of the class in which the design was registered, and had advertised and exposed such goods for sale, and had sold such goods. In the particulars the plaintiff set forth that on April 13th, 1896, defendants sold such a receiver and transmitter to Richard Hamel Wedekind, of Beckenham Grove, Shortlands; and on the 15th to Messrs. Wedekind & Co., of 5, Great Tower Street, City. He alleges that the defendants have been selling the infringing article to the general public since September, 1892. The defence is a denial of the alleged infringement. Defendants deny they have applied the design, or any fraudulent or obvious imitation of it, to goods of the class in which the design is registered, or that they advertised or sold such an article. If they had done so, they denied that they had done so fraudulently, or with knowledge that the consent of the plaintiff or his predecessors had not been obtained, or with knowledge of his alleged right. They assert that the plaintiff has no right to sue in respect of infringement, if any, committed by the defendants before the alleged assignment, if made, to the plaintiff, and they submit that the statement of claim showed no cause of action in respect thereof. They say further that before the alleged assignment, and before the alleged infringement, Anders and Kottgen caused or permitted articles to which the design had been applied, to be delivered on sale without having them marked with the prescribed mark, words, or figures denoting that the design was registered, whereby the copyright in such design ceased. They also say that the acts complained of were done by them, and the articles were delivered for sale by them, without any indication that the design was registered, with the permission of Anders and Kottgen. In their particulars, the defendants state that on November 29th and December 8th, 1894, Anders verbally sold and delivered to them four telephones of the alleged registered pattern, to be resold by them, and these telephones did not bear any mark, words, or figures denoting that the design was registered; and they believed that Anders did so with the knowledge of Kottgen. They state that on December 7th, 1894, and February 10th, 1895, Kottgen verbally sold and delivered to the defendants 23 telephones of the alleged registered pattern, to be resold, and they also were unmarked. They say that they were thus sold, they believed, with the privity of the Anders Telephone Company, Limited, or of G. L. Anders and Kottgen. At these dates Anders and Kottgen were interested in the Anders Telephone Company, Limited, as directors or otherwise. Defendants further say that in January, 1895, the telephone company gave them a license to manufacture and sell telephones of the pattern complained of; that in the license no stipulation was made that the telephones so made should be marked so as to denote that the design was registered; and that telephones were thus manufactured and sold by them under that license to the knowledge of Anders and Kottgen.

Mr. LEWIS EDMUNDS, Q.C., in opening the case, said that the action was brought in respect of the copyright in a registered design. The plaintiff was not the original proprietor, but was the assignee of the design, and was duly registered as assignee on the register of designs. The subject matter of the design was a combination of a telephone receiver and transmitter. It was not necessary to go into the details of the construction; but the design related to the shape, pattern, and configuration of these two parts, which together formed the improved apparatus for certain purposes. (The parts were handed up to his Lordship for examination.) Apparently there was no question of the validity of the registered design, except so far as there was an allegation that the plaintiff had lost his copyright in it by selling unmarked copies. Nor was there any suggestion that the instruments complained of were not substantially the same as that which his Lordship had before him. The substantial question was as to whether the copyright of the design had been lost by reason of the sale of specimens which had not been marked with the letters "Rd." and the number of the design, pursuant to the statute. He was content to base his case on the infringement subject to the assignment to the plaintiff. The section of the Act which related to this matter was Section 51 of the Patents, Designs, and Trade Marks Act of 1883, which ran as follows:—"Before delivery on sale of any articles to which a registered design has been applied, the proprietor of the design shall cause each such article to be marked with the prescribed mark, words, or figures, denoting that the design is registered; and if he fails to do so the copyright in the design has ceased, unless the proprietor shows that he took all proper steps to ensure the marking of the article." The "prescribed mark," under the Designs Rules of 1893, was, as set forth in Rule 5, as follows:—"Before delivery on sale of any article to which a registered design has been applied, the proprietor of such article shall cause the article to be marked with the abbreviation, 'Rd.,' and with the number appearing on the certificate of registration."

Mr. MCCALL, Q.C.: The substantial point is that under that rule the articles required to be marked "Rd.," and the number of the design.

Mr. EDMUNDS agreed. There seemed to be no doubt that numerous specimens of this combined transmitter and receiver apparatus sold by the defendants which had not had a registered mark upon them. That would not, however, affect the plaintiff under the section, for he could not compel the defendants to put the registration mark upon the infringing article. He could only proceed against them for the infringement. Anders and Kottgen, it appeared, were directors of the Anders Telephone Company, Limited, who were manufacturing these instruments. They gave the defendants a license, but he was instructed that that license had no reference to the registered design, but to the use of a certain patent; and although that patent had some relation to the design, the design was registered before the patent, and the telephone never at any time had any interest in the copyright of the design, and no license was ever given to the defendants to use the registered design. Moreover, the license expired on September 1st, 1895, or before the date of the infringements of which the plaintiff now complained. Therefore, apart from the question of marking, he did not see how the license could affect the question of infringement. The plaintiff's case was in its nature very simple. He would call the persons who were connected with the manufacture of those instruments, and prove by their evidence that unmarked specimens never left their establishment; that they were perfectly well aware that they would lose their copyright in the design if instruments which were unmarked were sold by them; and that every precaution which it was possible to take was taken, so that no unmarked instruments should go out of their works.

At this stage the Court adjourned for the day.

The hearing of the case was resumed on Tuesday, when Mr. MORESBY read the evidence of Mr. Richard Hamel Wedekind (who is at present abroad). Mr. R. H. Wedekind, in his deposition, stated that he was a partner in the firm of Wedekind & Co., 5, Great Tower Street, and he gave evidence as to the purchase of the infringing telephones from the defendant company at their premises in Queen Victoria Street, as to the illustrated advertisements of the same in the ELECTRICAL REVIEW and other papers, and as to the illustrated catalogue of the defendant company. Comparing the representations of the design in those advertisements with the representations in the catalogue of the Anders Telephone Company, he said that they were identical save for a slight difference in the filagree work on the telephone disc. The only other difference was that the pushers for ringing the bell in the defendants' instrument were slightly raised.

Mr. WILFRED CARL PHILIPOWITZ, clerk in the employment of Wedekind & Co., examined by Mr. MORESBY, said that acting on instructions he went to the General Electric Company's premises, Queen Victoria Street, on April 15th, 1896, and bought a telephone in the name of Wedekind & Co., and got an invoice for it. The telephone was produced.

Mr. JULIUS EDWARD WEDEKIND, examined by Mr. EDMONDS, said he was an electrical engineer, carrying on business at the Clerkenwell Road. He was owner of certain patents relating to improvements in telephones, and he was owner of the registered design on which this action was founded. In the deed of assignment he was called Edward without the Julius. He was generally known as "Edward Wedekind." He had a connection with the Anders Telephone Company, Limited. He was employed by that firm at their works, and was also a shareholder. He knew that they made their telephones according to the registered design, and that they knew about the necessity of marking them with "Rd.," and the number. All the instruments passed through his hands, and he saw that none passed out unmarked. He inspected them all. That was part of his duty, and he had instructions to see that they were marked. His own holding in the company was over £500. Mr. Anders and Mr. Kottgen were directors. None of the telephones passed into their hands without being inspected by him. His father had lent money to the company, and his father transferred the design to him.

Cross-examined by Mr. SCOTT: The Anders Telephone Company was registered on November 13th, 1893, and on January 25th, 1894, Anders and Kottgen assigned to the company the patents for this telephone. His father, Julius Christian Wedekind, became a debenture holder in the Telephone Company on August 9th, 1894, and on the same day a deed was executed empowering him to sell the patents and the goodwill of the company's business for the best price he could get. Later, the patents were assigned to witness. In January, 1895, the Anders Telephone Company and Julius Christian Wedekind, the debenture-holder, granted a license to the defendant company for the sole exclusive privilege of making these patent instruments for six months from March 1st. His company did not employ outsiders to make these instruments. Messrs. Newington, Priddle & Co., outside mechanicians, made some of the receivers for the Anders Company, because the company did not employ girl labour; but they did not make the complete instrument for the company, nor did they make transmitters for the company. If a person had a transmitter, and wanted to complete his apparatus, he could go and buy a receiver, connect the two parts by wire, and so complete his instrument; but witness had never sold the parts separately.

Mr. GEORGE LEE ANDERS was next examined by Mr. EDMONDS, and said that he was generally aware that it was necessary to have the instruments stamped with the registered number of the design and the letters "Rd.". So far as he knew, all the telephones sent out by the Anders Company were so marked. He had sold telephones to Mr. Max Byng, of the defendant company, but, to the best of his knowledge, they were all stamped.

Cross-examined by Mr. SCOTT: In the license granted to the defendant company there was no covenant that the defendants should mark the instruments they made and sold with the letters "Rd."

Mr. SCOTT pointed out that in the license the Telephone Company undertook for a special consideration to supply the defendant company with the dies and special machinery which they had for making these telephones; that the defendants did ask for the dies, and the Telephone Company furnished them, but there was none for stamping the registered number or the letters "Rd." on the instruments. He asked his Lordship to draw therefrom the inference that the Telephone Company consented to the goods being manufactured and sold without being marked as registered.

Mr. WALTER KOTTGEN, one of the original owners of the design, said he remembered selling some telephones to Mr. Byng at the end of 1894. He was not certain that they were marked; but they should have been, because he had given instructions from the first

that not a single instrument should be sent out without being marked as registered and with the number.

Cross-examined by Mr. Scott: He had been very strict in giving these instructions to his employés. He could not say why no stipulation was made in the license for the defendants marking the instruments they made under their license. It was all done by the solicitors. He thought he himself was not in England at the time.

Mr. Scott, in opening the case for the defence, said that the defendant company knew nothing whatever about this being a registered design. In December, 1894, one of the defendant company's witnesses bought four of these machines from Mr. Anders, and there were no marks denoting that they were registered. That being so, when the design was assigned to the present plaintiff early last year, the copyright in it was gone, and there was nothing to assign.

Mr. Max Byng was the first witness called for the defendant company. Examined by Mr. Scott, he said he was a director of the defendant company, and was a practical electrician. He purchased some instruments from Mr. Anders in December, 1894. He examined them, and found no mark denoting that the design was registered. He had discussed the matter of the license with Mr. Anders and Mr. Kottgen several times, and they never informed him that the design was registered. In January, 1895, he bought 14 of the instruments from Mr. Kottgen. He never received any dies for stamping the instruments with the registration mark, and the instruments he purchased had no such marks on them.

Cross-examined by Mr. Edmund ', Q.C.: His company manufactured from 500 to 600 of the instruments under the license, on the pattern of the Anders Telephone Company's instrument, though perhaps not the exact pattern.

Mr. Francis George Bell, manager of the telephone department of the defendant company, examined by Mr. Scott, said he had seen one of the instruments purchased by Mr. Byng, and it had no register mark.

Mr. Geo. W. Pitt, clerk to the solicitors for the defendant company, spoke of the negotiations for the license. He was familiar with the law requiring registered designs to be properly marked. When preparing the license he saw one of the instruments, but did not notice any registration mark upon it.

The case had not concluded when the Court adjourned.

The hearing of the action was resumed at the reassembling of the Court on Wednesday, and at the close of the arguments of counsel,

His Lordship delivered judgment. He said that the case raised a question of an embarrassing character from the fact that for a long period the plaintiff, who was now the proprietor of the design, was not the proprietor of the patents which referred to the instrument for which the design was registered. The design was registered on September 28th, 1892, by Mr. Anders and Mr. Kottgen. On January 25th, 1894, a number of patents obtained with reference to the instrument were conveyed by Anders and Kottgen to the Anders Telephone Company, Limited, but they did not convey the registered design. On August 4th, 1894, the company issued a debenture to Mr. Julius Christian Wedekind, father of the plaintiff, and gave him power to dispose of the company's property and goodwill. On February 26th, 1896, the company, and Christian Wedekind, assigned to the plaintiff the patents. They could not assign anything more, because they had nothing more to assign; and on March 7th the registered design was also assigned to him for a consideration which was next door to nominal—£1—so that for the first time there were the patents and the design in the one hand. Mr. Wedekind was now seeking an injunction to prevent the Electric Company from selling those telephonic instruments during the continuance of the copyright in the design. The defendants were selling them, and the answer they made was that the plaintiff was not entitled to prevent them, that he was not entitled to interfere with them at all, because the copyright of that design, before the sale of it to the plaintiff, had been lost by reason of the proprietors of the copyright contravening Section 51 of the Trade Marks Act, 1883. That section enacted that before delivery on sale of any articles to which a registered design applied, the proprietor of the design should cause each such article to be marked with the prescribed mark, and if he failed to do so, the copyright in the design should cease unless the proprietor showed that he had taken all proper steps to ensure the marking of the article. The case for the defendants was that the proprietors of the design—Anders and Kottgen—had delivered the article on sale without its being marked, and so had lost the copyright; and, further, that they could not get protection under the closing words of the section, because they could not show that they had taken all proper steps to ensure the proper marking of the articles. The question for the Court was whether the then proprietors of the copyright, before delivery for sale, failed to have the articles marked with the prescribed words, which, for an article in the class in which this one was registered, was "Rd." and the number of the certificate of registration, 199,598. In this case he was clearly of opinion that both the proprietors, Anders and Kottgen, concurred in what was done; and even if they had not, they were in the position of partners, and the acts of one would bind both. The defendants said that Anders and Kottgen had sold the article unmarked. The plaintiff, in his evidence, had told them that he was employed by the Anders Telephone Company at their works in Clerkenwell Road; that he knew of the marking rule; that he saw that all the instruments sold were marked; and that it was a special part of his duty so to do. Such evidence required a distinct answer. Anders was next called, and it was clear that he and Kottgen were under the impression that the company they formed got the rights in this design, although they were wrong in that belief. Anders sold four telephones to the defendant company, and on the evidence his Lordship proceeded to show that at least one was certainly not marked, and that probably some of the others were unmarked also. Anders did not know at that time that there was any penalty for not marking the goods, but he knew that the practice was to have them marked. Kottgen knew the rule, and had given instructions that every article should be marked; but he could not swear that all those which he sold were marked. His Lordship had been impressed with the perfect fairness of Mr. Anders and Mr. Kottgen in giving their evidence. There could be no doubt that on December 8th, 1894, there was a delivery on sale by Anders of an unmarked instrument, and on the whole evidence the proper conclusion to be drawn was that these instruments, not many, perhaps, but some, were sold unmarked before the license was granted to the defendant company. But even supposing that were not so, the license to the defendant company was granted as from March 1st, 1895, and during that period Anders even acted for the defendant company at their works. In handing over, under that license, the necessary plant for the manufacture of the instruments, the stamp for impressing the registration mark was not handed over; and thus there was something that might be described as an invitation on the part of the licensors—the Anders Company—to the defendants to manufacture the unmarked article. That was the only conclusion he could draw from the conduct of the parties during the negotiations preliminary to the granting of the license. The true result of the evidence appeard to be, that there was acquiescence on the part of both the proprietors of the copyright, Anders and Kottgen, in the delivery for sale of unmarked articles, and there had been actual sales of them by Anders. It appeared to his Lordship that the two proprietors acquiesced in the sale—during the continuance of the license at all events—of the unmarked articles. They had so acquiesced as to deprive them of their copyright, unless they could show, under the last clause of the section, that they had taken all proper steps to prevent the sale of the article unmarked. They had not done so, but had stood by and acquiesced in it. His conclusion, therefore, was, that the proprietors of the copyright had delivered on sale these articles without the prescribed mark in several instances before the granting of the license; and that since the granting of the license their conduct had had the effect of permitting further such sales.

Judgment was accordingly entered for the defendant company, with costs.

Rigg *v.* Richards.

The applicant, George Richards, of Suffolk House, Laurence Pountney Hill, London, sought to obtain letters patent for an invention for "Improvements in kinetoscopic projecting apparatus." The opponent, John Henry Rigg, of 43, Skinner Lane, Leeds, opposed the grant of the patent, on the ground that prior letters patent had been granted for a portion of the invention, under Patent No. 6,731, of 1896 (Rigg and Kumberg). Brewer & Son, patent agents, of Leeds and London, appeared for the opponent, and Allison Bros., patent agents, of London, acted for the applicant.

Both opponent's and applicant's inventions relate to kinetoscopic and like apparatus, and in each of them there occurs a mechanical arrangement for giving to the travelling film rapid intermittent motion. The Comptroller, in giving his decision, says that there is actual identity between the two inventions, and he therefore before sealing a patent to the applicant, requires him to insert in his specification the following reference and disclaimer:—"I would have it understood that I am aware of the specification of letters patent granted to Messrs. Rigg and Kumberg, No. 6,731, A.D. 1896, in which a mechanism is described for giving rapid intermittent motion to the picture film, viz.:—A worm wheel and worm with angular teeth on a small portion of the circumference, and I therefore make no claim to such mechanism."

The opposition therefore succeeds.

Elliott Bros. *v.* Sullivan.

High Court of Justice—Court of Appeal. (Before Lords Justices Lindley, A. L. Smith and Rigby.)

On Tuesday last this case came on for hearing on appeal by the plaintiffs from an order of Mr. Justice Kekewich, dismissing the action with costs, and on the defendant's counterclaim granting an injunction against him from infringing letters patent relating to an instrument known as Sullivan's Universal Galvanometer.

Mr. Rensbaw, Q.C., and Mr. Stone appeared in support of the appeal, which was opposed by Mr. Warrington, Q.C., and Mr. Jason Smith.

Learned counsel, in opening the appeal, said that the plaintiffs were electrical engineers and manufacturers, of St. Martin's Lane, London, and the defendant, who resided at Ladbrook Square, Notting Hill, was the holder of the letters patent of Sullivan's Universal Galvanometer. Plaintiffs, by their action, sought to enforce an agreement, by which they were entitled to manufacture and sell, as sole licensees for the defendant the instrument in question, and they asked for an injunction restraining the defendant from granting licenses for the manufacture of the said galvanometer to any other person, or otherwise interfering with their rights under the agreement. The defendant, while admitting that negotiations had taken place between the plaintiffs and himself with reference to some such agreement, had never executed such a document. He counterclaimed for royalties on instruments already made by the plaintiffs, and for an injunction restraining them from infringing the letters patent. His Lordship, in the Court below, came to the conclusion that the agreement never took such complete form as to be available as a binding document, and accordingly dismissed the action and granted the defendant the injunction asked for. What the plaintiffs objected to was the granting of a perpetual injunction, as it would prevent their manufacturing these instruments should the patent be declared invalid.

Lord Justice Lindley asked if it would meet the plaintiffs' view if the words "during the continuance of the patent" were substituted for the "perpetual injunction."

Mr. Renshaw said it might be that no one else would care to try and upset the patent.

Mr. Warrington said he could not object to the words being inserted "during the continuance of the patent."

Mr. Renshaw thought that hardly went far enough for him.

Lord Justice Rigby: You want the opportunity of infringing so as to test the validity of the patent?

Mr. Renshaw said that was what they would like.

Mr. Warrington having addressed their Lordships,

Lord Justice Lindley, in giving judgment, said that they had come to the conclusion that the main question really depended upon whether the parties ever entered into a binding agreement, and having regard to the correspondence, and to the evidence relating to the interview of July 10th, 1894, which was the important interview introducing this matter, the conclusion to which he had arrived was that from the very first the parties intended to put the terms to which they might agree into writing, and then consider them as a whole. There was so much sense in that from a business point of view, that he was not surprised that the correspondence, and what took place at the interview, supported that idea. That being so, it was quite obvious there never was any concluded agreement at all. When the draft agreement was drawn up, the terms in it were never so assented to as to be binding upon the defendant. There were a great many things which it appeared to him had not been finally assented to, and which were subject to the final agreement in writing being approved of. It seemed to him the sound conclusion to come to, was that there was no final binding agreement. That disposed of the real point in the case, but there was another part of the case which had been dealt with. The injunction which had been granted restrained the plaintiffs from infringing the defendant's patent. Now, the plaintiffs had never dreamt of disputing the validity of this patent; but they said the injunction placed them in the invidious and anomalous position of not being able to dispute its validity. Now it was most obvious they could have done so, but they ran their case, not on the ground of invalidity of the patent, but upon the ground on which they felt most sure, viz., that of the agreement. Mr. Warrington had, however, agreed to the substitution of the words "during the continuance of the patent," instead of "perpetually restrained," and with that alteration the appeal would be dismissed with costs.

Lords Justices Smith and Rigby concurred.

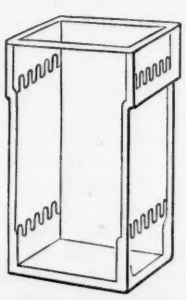
Electric Construction Company *v.* Hurry & Young.

This was an appeal from the decision in favour of defendants given by Lord Low, and reported in the Electrical Review, June 26th, 1896. The appeal came on at Edinburgh on 14th inst. The First Division of the Court of Session (Lord Kinnear dissenting) recalled the interlocutor pronounced by Lord Low, and decerned as craved, in an action by the Electric Construction Company, Limited, against Hurry & Young, electrical engineers and contractors, Edinburgh, to recover £50 13*s.* 6*d.*, the price of a No. 3 dynamo, which the defenders purchased from the pursuers in September, 1894.

CORRESPONDENCE.

Patent Accumulator Boxes.

According to the *Zeitschrift für Elektrochemie*, Messrs. Beyer & Co., of Kohlfurth, Germany, have lately taken a patent for an accumulator box of glass, in which two sets of small "steps" (as shown) are cast, one set low, the other at the top of the box. On the higher steps the side lugs of the plates rest, whilst the lower ones act as channels for the lower corners of the plates, so that the plates are free to expand in all directions without risk of short-circuit.



The plates hang high above the bottom of box, so that short-circuit by deposited paste is also not to be feared.

This arrangement has also the advantage that the spaces between the plates are quite clear, so that with the aid of a lamp, any short-circuit in the shape of paste, or expanded or buckled plates, can at once be perceived.

Another advantage is that the whole active surface can be acted on equally, as no separators cover any part of the plates, and thus expansion in any one direction more than another is obviated. As for strength, it may be said that the glass boxes are so constructed, that they could carry a much heavier weight than that of the plates.

The patentees claim that these boxes are especially suitable for traction purposes, but that can hardly be the case, as the plates are not so very tightly fixed, and thus the whole cell cannot be considered very compact.

E. B.

Double-pole Main Fuses.

With regard to the remarks of your correspondent, "Safety Fuse," in your issue of 15th inst, I shall be obliged if you will kindly allow me to state the reasons of the Chelsea Electricity Supply Company for framing the regulation to which apparently he takes objection.

It appears to me that the point is not so much what are the powers of the company to enforce the regulation, since the Board of Trade would support the company in any reasonable regulation they may make for the protection of the interests of the householders and of themselves, but rather whether such regulation is made in the true interests of electric lighting in general, and is consequently deserving of the support of the consulting engineers and contractors themselves.

The supply company fixes a double-pole main fuse at the point where the mains enter the building, and they hold themselves responsible for maintaining these fuses in proper condition. Much care has been exercised in the selection of a thoroughly reliable pattern of cut-out, and I may say that for over three years there has not been a single failure of the light in a house on the Chelsea Company's circuits which has been due to a defect in the company's main fuse. It is in the interest of the company to keep these fuses as small as possible, since the chief object of the fuse is not so much to protect the street mains, as is generally assumed, but rather to protect the company's meter. Especially in the case of meters working on the motor principle, an excess of current beyond the proper capacity of the meter is disastrous. What reason, then, can there be for the contractor to fix a second main double-pole cut-out in series with the cut-out already fixed by the company? I maintain that not only is this second cut-out an unnecessary weak point in the wiring, but that it is most objectionable as being a fruitful source of annoyance and inconvenience to the consumer, and consequently also to the supply company.

Your correspondent has not chosen to sign his name, but as no objection has ever been made to this rule except in one particular instance, I am able to give you the contents of the letter which was written to him at the time he raised the objection, and which gives in detail the reasons which induced the Chelsea Company to adopt the rule:—

"With regard to the main house fuse, we appreciate your remarks, but you are under a misapprehension as to the really serious amount of trouble which these fuses have caused in the past to the supply company. We must ask you to believe that we make as few and as simple rules as possible for the protection of our consumers and ourselves, the interests of both being in this case identical. We can understand that objection may be taken to any regulation which increases the cost of wiring a house, but as this particular rule actually lessens the cost, we are somewhat surprised that any objection should be raised.

"The rule was only framed after very careful consideration, as we are always anxious to leave, as far as possible, the internal arrangements for electric lighting to the discretion of contractors and consulting engineers.

"We feel sure that if you realised the extent of the nuisance and trouble which these particular fuses have formerly caused to our consumers and ourselves you would not have made the statement that the objection on our part is 'ultra vires,' and, on the contrary, you would agree that the rule is only reasonable. We have formerly frequently had to send someone out to a house at all hours of the night on receiving a report that all the lights were out, and we have continually found that the mishap was due to the failure of these main house fuses caused by a bad contact, or the sectional area of the wire being reduced by the terminal being tightened down directly on to the soft fuse wire, or by

neglect of proper inspection and deterioration of the fuse wire. Although we were not responsible for this state of affairs, we could not very well refuse to oblige a customer by inserting a new fuse in his cut-out, but there is no doubt that in the majority of cases the consumer considers the Supply Company is to blame for the extinction of the lights. These failures are most likely to occur when there are guests present at a dinner party or reception, as frequently a larger number of lamps are in use on these occasions. Strangers are sure to make the remark that the electric light is 'always going out,' and in consequence the damage done to electric lighting in general is very serious.

"We have written you very fully on this matter as we do not wish you to be under the impression that we are carrying out an arbitrary and unnecessary rule."

In conclusion, I should like to point out that, although "Safety Fuse" protests against the company's objection to his fixing a second double pole cut-out, he omits to state any reasons for wishing to fix two cut-outs in series. It would be interesting to know these.

Percy Still.

January 16*th*, 1897.

Referring to the letter of your correspondent, "Safety Fuse," it may interest him to know that it is our invariable custom, in installations carried out under our supervision, to insert a pair of consumers' main cut-outs, set to blow before the company's fuses do.

We cannot recall any case where objection has been taken to this, although we have had to deal with all the London companies, and most of the principal provincial ones; and certainly in no case have we relaxed our rule.

In our experience, the station engineers welcome the arrangement as an additional safeguard, and as likely to save them some slight trouble in replacing fuses.

Handcock & Dykes.

January 16*th*, 1897.

Speed Regulation of Direct Current Motors.

It was with much interest that I read the article entitled "Speed Regulation of Direct Current Motors" in the issue of the Electrical Review of the 8th inst. As therein stated, the E.M.F. method of control is not applicable where the source of power is a supply company's mains; nevertheless, where such is the case, by inserting the regulating rheostat in series with the armature of the motor, and maintaining a constant P.D. at the terminals of the field magnets, by taking current for the same from some point on the main's side of the rheostat, though the economy of working is not increased, as is the case with the E.M.F. control in the generator, *yet the constancy of speed of the motor under a variable load is thereby effected*, a feature in many instances of no little importance.

Also in the case of a private plant, where the generator is required to be maintained at a constant voltage for the purposes of light, by inserting a rheostat in series with the armature of motor, and running a separate pair of wires to the terminals of the field windings of motor, either from the generator, or where secondary cells are installed from them; in either case there is still attained the advantage of a practically constant speed under a varying load.

J. R. Dixon.

January 18*th*, 1897.

The Telegraph and Berne Convention.

Please let me briefly close with Mr. Hill.

The companies do not "for obvious reasons" attempt to establish uniformity, or it would have been attained before 1897.

Mr. Hill does not seem able to grasp the object in view, to get a symbol which will distinguish the difference between 3 shillings and 4 pence 3/4, and the fraction three over four, $\frac{3}{4}$.

Telegraphy is an "old infant," and all endeavour should be to escape from that whole faith which leadeth to everlasting rest—and rust.

The Writer of the Article.

January 18*th*, 1897.

Mechanical Theory of Electricity and Chemical Action.

Judging from Mr. Haycraft's letter, he appears to have got himself into a very serious "*impasse*" indeed, and I will willingly try and help him to get himself out. First about the cubes; that Mr. Haycraft has always believed them to be as like as two peas, or that he finds it incredible that they differ, is no evidence. All experiments with an exploring coil and ballistic galvanometer can be explained on my hypothesis, and are consistent with a difference of density. In the case of the ring, Mr. Haycraft is a little premature; if he had waited a week and read the description with reference to fig. 5, he would have been able to see that inside his ring there will be no change of density on a circle concentric with the ring but merely a radial change. I again appeal to experiment and predict that in a coil moved inside the ring parallel to the so-called direction of lines of force a current will be generated.

Arthur Whitwell.

Wimbledon, *January* 15*th*, 1897.

It is very easy to find fault with a *definition*, but there is nothing unreasonable in Mr. Whitwell's supposition of the variation of the density of the ether. It is not more extravagant than the two fluid theory, or the cruel kinetic theory of gases, where

Birds in their little nests agree
Until away they fly;
But molecules, in time $d\,t$,
Collide π times $f\,(\pi)$.

With indebtedness to Dr. Watts, D.D., and to Dr. Watson, F.R.S.

R. C.

Telephone Trunks.

Will M. Pierart be good enough to explain the purpose of the shunted condenser shown in his diagram as interposed between the line and the first graduator? It is absent from Van Rysselberghe's original design. Is it intended to facilitate the working of the telephones, or of the Morse signalling? What relation does its capacity and resistance bear to the self-induction of the graduators? Again, will he give the time constant of a line of iron wire 4 mm. in diameter, 200 miles long, fitted with the apparatus he shows, or, if he prefer it, will he state the number of words per minute he would expect to transmit in the Morse code through such a line?

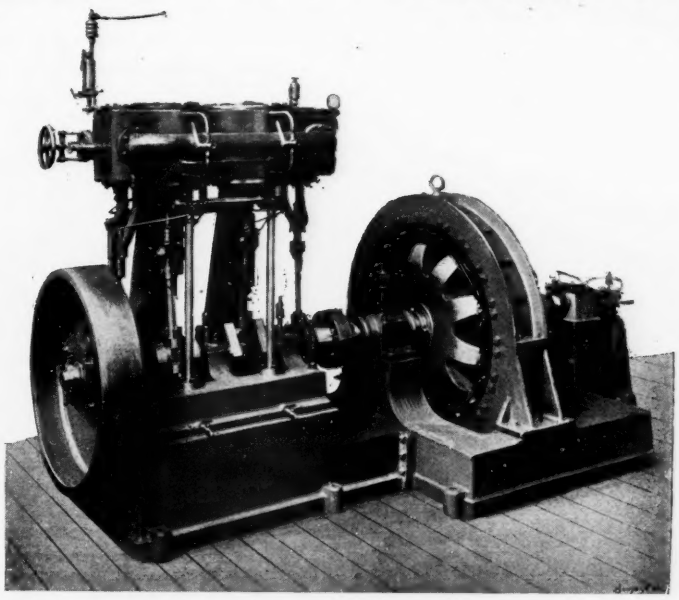
J. Gavey.

January 21*st*, 1897.

Electrically Propelled Omnibuses.—According to the *D. T.*, a successful run of an electric omnibus for a period of 34 minutes is evidently considered something to be proud of in these advanced days of traction; yet when one comes to think of it, a run of this duration without a stop is about the easiest performance for any motor that could well be called for. Thirty-four stops and starts in an hour would be quite the opposite, and one which would come nearer to practical working. Then again, we are told that "*upon examination*" the batteries were found to have given off only one-eighth of their charge! Now this *is* interesting to battery experts, as we have never before heard of any kind of "examination" which could reveal the state of charge of a battery not fully discharged till the voltmeter shows a fall below 1·8 volt or so. A battery still seven-eighths charged could not have its charge gauged by any examination whatever, except by running out the remaining charge and carefully measuring the output. Then we are told the batteries weigh 23 lbs. each, and 70 of them are used, but we are not supplied with information on those most important points, capacity and maximum discharge over any given time. When will newspapers recognise the necessity of employing experts on scientific matters to write their scientific articles?

THE ELECTRIC LIGHTING OF ST. HELEN'S.

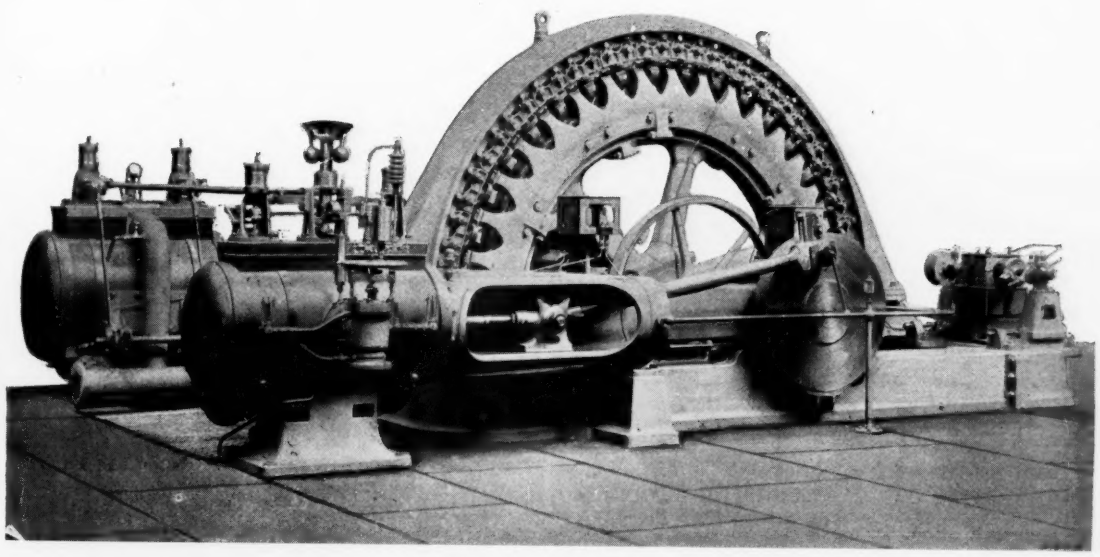
In spite of the general prosperity, and the public regard for progress in St. Helen's, it is only recently that a municipal central station has been ventured upon. The town is well provided with shops and public places, is not too scattered, and should provide a paying load. The site of the central station is on the Corporation gas-works. Although the plant at the present moment is not extensive, the buildings have been erected with the idea that the demand for current will soon exceed the output, and that new machinery will soon be necessary. There are two Lancashire boilers, arranged in a manner very common to Lancashire; that is, in a boiler house which is completely open to the yard. The most distinctive features of the boilers are the use of Perrett's furnaces, which are specially adapted for the burning of inferior fuels, and Granger's forced draught apparatus, both of which improvements have been referred to more than once in the columns of the Review. In passing, it might be mentioned that on the occasion of our visit cheap fuel was being used, and we gathered that it was the intention to use coke breeze, tempered with inferior coal. There is a pleasing absence of many of the super refinements that have been much affected in central stations, and we do not think that the St. Helen's steam-raising plant will be any the less efficient for that. The boilers have been made by Messrs. Yates & Thom, and are of 7 feet diameter and 30 feet long; they work at a pressure of 140 lbs. per square inch, and are each capable of evaporating 5,000 lbs. of water per hour. A Berryman feed-water heater is employed, and a surface condenser, both being supplied by Messrs. Wright, of Tipton. The boiler mountings are by Hopkinson, of Huddersfield.



Day Load Plant at St. Helens.

The whole of the main steam pipes and the larger bends are of lap welded steel, the subsidiary steam pipes for the steam feed pumps being of lap welded wrought-iron. The main exhaust pipe, which is 15 inches in diameter, and designed to deal with the extensions, is carried underground, and connected to a single uptake pipe, so that the exhaust steam, in the event of not working condensing, may be delivered into the atmosphere direct.

The combined engines and electrical plant is one of the most interesting features of the works. A good idea of the appearance of the plant will be gained from the illustrations. The large unit consists of a combined arrangement of engine and alternator. The engine, which is by Messrs. Robey and Co., is of the horizontal compound condensing type. It is of 180 I.H.P., but has no difficulty in working up to an emergency load of 210 I.H.P., and even beyond if necessary.

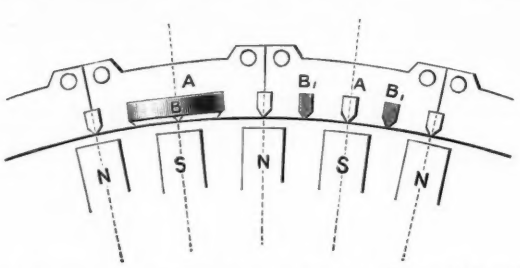


Combined Engine and Alternator at St. Helens.

The valve gear is of the Richardson-Rowland type. As the main alternator forms an integral part of the engine, as it were, it will be best to describe it now. The specification demanded an alternator, built between the beds of the engine, capable, at an E.M.F. of 2,000 volts, of delivering to the external circuit 100 kilowatts as an ordinary continuous load,

and on an emergency, of continuously delivering 115 kilowatts for two hours.

The alternators have been supplied by Messrs. Johnson and Phillips. The field magnet of the large machine is combined with the engine fly-wheel. The armature coils, 36 in number, are embedded each in a block of finely laminated iron, these blocks being carried in a substantial cast-iron exterior shell surrounding the field magnet and bolted to the engine bed-plate. The field magnet is excited by a single coil of wire wound on the fly-wheel rim, the latter being flanged for the purpose, while the pole-pieces are formed by segmental steel castings bolted to the fly-wheel, and forming, when laid together, a complete circle on each side of the rim. The engine is compound with the cranks at right angles, the alternator occupying a position between the two cylinders. The high pressure cylinder is 17½ inches in diameter, and the low pressure 23½ inches, the stroke being 33 inches, and the normal speed 100 revolutions per minute. The exhaust from the high pressure goes into a receiver fixed between the two cylinders under the floor, thence to the low pressure cylinder. All the working parts are of ample strength, the shaft 8 inches in diameter at the journals, being swelled up to 12 inches in diameter at the centre where the fly-wheel is keyed on. The normal output

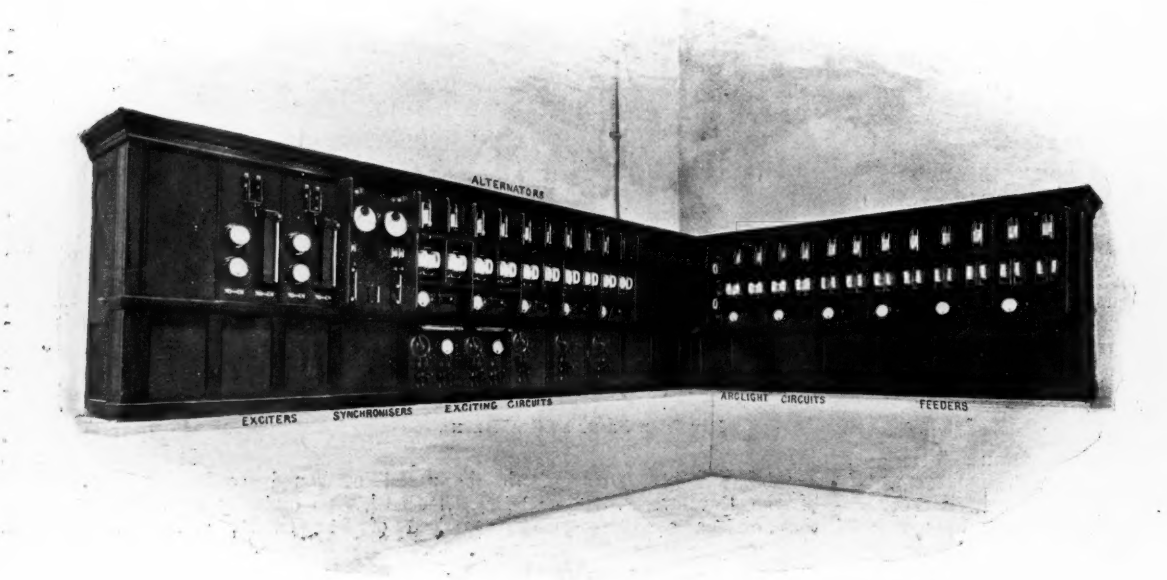


Arrangement of Magnet Poles and Armature Coils on St. Helens Alternator.

of the combined set is 115 kilowatts at 2,000 volts, the frequency being 60 per second. The exciting current is supplied by one of Johnson & Phillips continuous current dynamos, mounted on sliding rails on the alternator bed and driven by ropes from the engine crank shaft.

It may be mentioned that the large machine is constructed in accordance with a design patented by Mr. W. B. Esson, that the armature coils are all machine-wound, and are afterwards inserted into the armature segments in such a manner that the segments, when laid together, present to the field a surface of unbroken continuity. It will be seen that there are *half* as many armature coils as there are magnet poles. The sketch shows this. N and S are poles and A, A, two armature blocks. B is a coil in elevation, and B_1, B_1, a coil in section, there being one coil to each armature block. The field tips are laminated to the same degree as the armature blocks.

The remainder of the generating plant consists of a small direct coupled engine and alternator; this, also, is shown in one of our illustrations. The engine is a vertical compound engine of 50 I.H.P., and is by Robey & Co. The alternator



Malta Switchboard.

is direct coupled on to the crank shaft. The bearings are of ample surface, and the lubricating arrangements are of an efficient character. The normal output of the alternator is 25 kilowatts at 2,000 volts, though the emergency output is 30 kilowatts. This combination is designed as the dayload plant, though the two sets run well in parallel. It will be seen from the illustration that the exciter for the small set is driven from an extension of the shaft.

The switchboard is of the Ferranti single-pole type, and is similar to many others of this firm, which we have described.

There is, at the present moment, practically one high tension circuit, which consists of a concentric cable, B.I.W. type. The inner core is made up of 19 strands, the outer conductor being of equal section to a 9/14 cable, both conductors insulated from each other and from earth, followed by a lead covering, and double braided over all. The low tension mains are of the concentric type. The whole of the mains are laid in cast-iron pipes.

The transformers are placed in street boxes, and contain one or two new features, which will be described in a subsequent issue. It may be mentioned that they have been supplied by the Leeds and London Electrical Engineering Company.

From enquiries which we made, there seems every reason to expect that the demand for current will more than keep pace with the output.

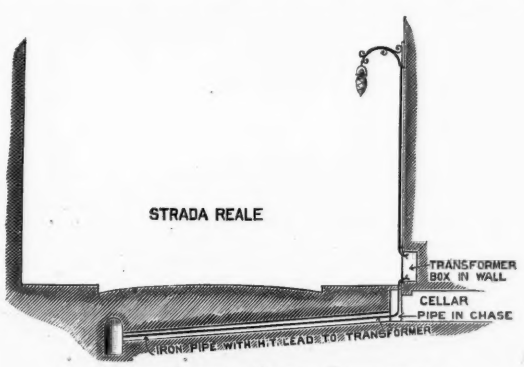
The consulting engineer for the whole of the work is Mr. Robert Hammond, Mr. Samuel Glover, the gas engineer, giving the necessary supervision. Mr. F. M. Short has represented Messrs. Johnson & Phillips during construction, while Mr. A. H. Clarke is electrician in charge of the station.

MALTA ELECTRICITY SUPPLY.

The Electricity Supply Works, which have been undertaken by the Government of Malta, commenced supplying current on December 1st, 1896, and are interesting to engineers and members of local authorities in that the Government have not only provided machinery and mains for supplying private consumers, but have dispensed, at the outset, with gas lighting in the public streets and squares, for which they have substituted incandescence and arc lamps.

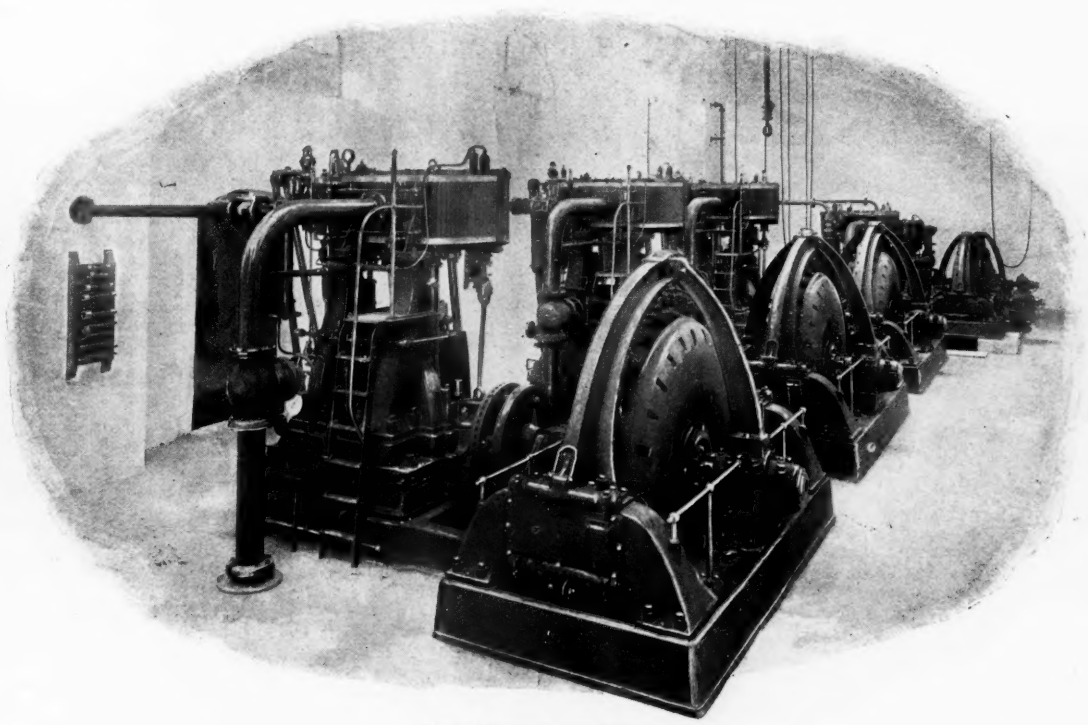
The Electricity Works are equipped with machinery capable of dealing with 375 kw., and of this the public lighting alone requires 124 kw., so that with private consumers, among whom are the Governor's Palace and several of the War Department buildings, the works may be considered to have started with a paying load.

In setting about the scheme the Government consulted Mr. W. H. Preece, C.B., F.R.S., and he, assisted by his son, Mr. A. H. Preece, drew up a scheme upon which tenders were invited, when that of the Brush Electrical Engineering Company was found to be the most advantageous for the whole of the work. The distribution of electricity is effected by low tension alternating currents with transformers fed by high tension feeder mains running from the generating station to various points in the towns.



Section Showing Street Connections.

In Malta, long distances have to be traversed; the longest feeder being that to the Three Cities, a distance of 5,000 yards from the generating station to the first chamber. The towns of Valetta and Floriana are intersected throughout with subways, which have existed for centuries, having been apparently used as sewers by the Knights of St. John. Advantage was taken to lay the cables in them as far as possible. The generating station is situated on the Marina, adjoining the Custom House, and comprises an engine room 109 feet × 26 feet, and a boiler and condenser room 109 feet × 25 feet. Excellent coal stores and water tanks are provided, and ample room is provided for extensions both to the engines and boilers. The work of arranging the building has been in the hands of Mr. Gatt, C.E., the Government engineer.



Malta Engines and Dynamos.

The following detailed description of the works may be of interest:—

Steam is supplied to the first instalment of plant from three Babcock & Wilcox water tube boilers, each capable of evaporating 6,000 lbs. of water per hour at a working pressure of 150 lbs. per square inch.

The heating surface of each is 1,827 square feet, and the grate area 33½ square feet.

The drums are 48 inches in diameter × 23 feet 7 inches long, and are each provided with two safety valves, one non-return steam valve, one steam stop valve, duplicate feed and check valves, and all the latest improvements in water gauges, &c.

Soot cleaning apparatus is fitted to each, by means of which sooty deposits are blown off the tubes. A ladder and gangway across the top of the boiler is provided, and the brickwork fronts are finished off with buff and white glazed bricks. Firing is done by hand.

The main steam pipe, which is of wrought-iron 6 inches in diameter, is in the ring form, with valves so arranged that any portion of the ring may be easily isolated without interfering with the working of the engines. Copper expansion bends are employed where necessary.

The valves are of the parallel slide type.

Water separators are provided in the main steam ring as well as on each engine, which are drained by Geipel's patent steam traps.

The exhaust piping, which is of cast-iron, ranges from 12 inches in diameter downwards, is arranged to either open into the condenser or direct to atmosphere, as may be desired. There is an automatic relief valve on the pipe, which opens

the exhaust to the atmosphere in the event of stoppage of the condensing plant, and there is also a valve for shutting off the condenser when required.

All the steam piping is covered with magnesia sectional non-conducting covering.

There is one duplex feed pump 6 inches × 4 inches × 6 inches stroke, and two injectors (one spare), each capable of delivering 3,000 gallons of water per hour.

They are arranged to supply the boilers direct from the town mains, or from a galvanised W.I. tank, the latter being heated by the exhaust steam from the feed pump.

The feed pipes, which are of galvanised wrought-iron, are also on the ring system, with suitable valves for isolating any section, and this piping is also covered with magnesia sectional non-conducting material. The exhaust steam is condensed by a Ledward patent ejector condenser, capable of dealing with 600 I.H.P.

The cooling water, which is obtained from the sea, is supplied by two centrifugal pumps, each capable of delivering 35,000 gallons of water per hour, one being coupled direct to the shaft of the Brush 6 inches × 5 inches vertical engine, the other being driven by means of belting, and an alternate current motor.

The pumps are fitted with gun-metal discs and manganese bronze spindles, and each has an air ejector for charging with water before starting up.

A Mordey Victoria transformer, 2,000 to 100 volts, supplies current to the motor, and there is a switchboard with ammeter and high and low tension switches and fuses for controlling it.

The cooling water is taken from a deep pump, into which the sea water flows, and the discharge is also to the sea; the condensing water pipes are all 7 inches in diameter, and of cast-iron. A non-return valve and strainer are fitted to the suction, and suitable sluice valves are placed where required.

There are five main engines, three being of 166 I.H.P., and having cylinders 11½ inches × 20 inches × 12 inches stroke, and running at 231 revolutions per minute. One of 84 I.H.P., with cylinder 8½ inches × 15 inches × 8½ inches stroke, and running at 273 revolutions per minute; and one of 40 I.H.P., with cylinders 7½ inches × 12½ inches × 7 inches stroke, and running at 300 revolutions per minute.

The high pressure cylinders are provided with piston valves and the low pressure with ordinary slide valves.

Steam is controlled by highly sensitive fly-wheel governors, and Hackworth gear is provided for varying the L.P. cut off whilst running.

Raworth patent flexible couplings are used for coupling the engines direct to their respective alternators.

There are five alternators of the well-known Mordey Victoria type. Three of them have an output of 100 kw. each, and the other two 50 and 25 kw. respectively.

The armatures are stationary, as usual, in this type, while the field magnets revolve. They generate current at a pressure of 2,000 volts.

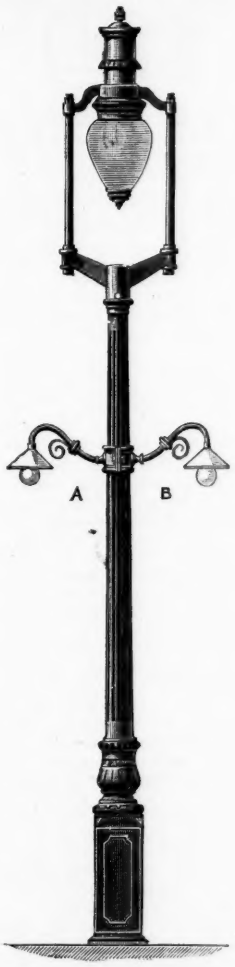
These alternators work perfectly in parallel with each other irrespective of size; the lubrication is automatic, being effected by small pumps which keep up a constant circulation of oil. The exciters, four in number, consist of two compound wound Brush-Falcon two-pole dynamos, each having an output of 12,000 watts, and coupled direct to

Plan of Mains, Malta.

Brush compound tandem engines, 6 inches × 10 inches × 8 inches stroke, upon one bed-plate, and two small exciters are coupled directly to the 50 and 25 kw. alternator shafts, so that the day load plants have each their own exciter.

The 12 kw. exciters are each capable of exciting all the alternators running at one time, so that ample provision is made as regards safety and meeting both full and day load requirements economically.

The main switchboard consists of the following separate slate panels:—Two exciters, one synchroniser, five alternators, and six circuits, mounted together in a handsome polished teak frame, and standing in one corner of the engine room upon a raised platform. Two sets of omnibus bars are arranged at the back of the board, so that any alternator can be put either singly or in parallel on either set of omnibus bars.



The high tension switches throughout are of the Brush quick action trigger type with mechanical make and releasing gear, and the high tension fuses are of the Bates pattern, enclosed in porcelain handles. The low tension switches are of the Brush chopper type.

Suitable measuring instruments are provided on each panel, and the whole station is regulated by the rheostats which control the exciters. Each alternator is also provided with a resistance for compensating the change in resistance in the field circuits due to temperature variations.

There are two small panels (placed underneath the 50 and 25 kw. alternator panels), containing instruments, switches and fuses, and regulating resistances for the two small direct-coupled exciters.

Ample provision has been made on the board for extensions.

The engine room is spanned by a 10-ton travelling crane, with hoisting cross travelling and longitudinal travelling motions, all worked by hand ropes from the floor level. For light loads up to 5 tons, the return block may be removed, and the single chain used, the free end being provided with a 5 tons swivel hook.

The current is carried from the generating station on the Marina to Valetta, Floriana, and Three Cities, by means of concentric high tension feeders insulated with specially treated paper, lead covered and armoured, and laid direct in the ground, or drawn through the numerous subways which exist throughout Valetta and Floriana.

These feeders have a section of ·1 square inch as far as the Three Cities, a distance of 5,000 yards, ·063 to Valetta, and ·035 to Floriana, and terminate at the principal sub-chambers. From thence high tension distributors, insulated and protected in a similar way to the feeders, but varying in size from 7/14 to 7/20 in size, are taken to the sub-chambers, which are placed at convenient centres for distribution. Special high tension isolating switches, enclosed in cast-iron boxes, are fixed at convenient points, and Geipel patent high tension joint boxes are used for jointing; the joints being mechanical, are easily made, and may be inspected by removing the cover.

Each high tension feeder contains specially insulated pilot wires, and these are connected through highly insulated plugs to an electrostatic voltmeter on the main switchboard, thus enabling the station attendant to readily ascertain the pressure at the feeding points. The low tension distributing mains consists of ·180, ·154 and ·077 square inches concentric cables, insulated with specially prepared paper, lead covered, and armoured with steel, similar to the high tension feeders. The house service connections are made with vulcanised rubber concentric cable, drawn through galvanised wrought-iron pipes; the joints are made with Geipel patent joint boxes, and the cable terminates in the Brush Company's specially designed lock up cast-iron switch fuse box, fixed on the consumer's premises.

The transformers are placed in sub-chambers cut out of the solid rock, or in war departments or public buildings.

At present there are 46 transformers in use, varying from the 18 kilowatt size down to 2 kilowatt. They are of the Mordey Victoria type, enclosed in cast-iron water tight cases, and provided with earthed shield between the primary and secondary coils.

Current is transformed from 2,000 volts primary to 210 or 105 on the secondary; and besides the primary switches and fuses contained in the transformer case, switches are also provided in cast-iron boxes, and inserted between the high pressure supply and the transformer. Geipel's patent "gabled top" joint boxes connect the high pressure mains to the transformers, and each box is provided with connectors for three transformers.

Low tension switch fuses and gun-metal omnibus bars convey the current from the low pressure side to the circuits.

Public Arc Lighting.—The first instalment consists of 60 arc lamps, 45 of which are placed round the Grand Harbour, and the remainder in the Palace Square and Strada Reale.

All, with the exception of two suspended from brackets, are fitted into frames mounted upon ornamental cast-iron posts designed and made by the Brush Company at their Falcon Works. The lamps are of the Brush Vienna 15 ampere alternate current type, arranged to burn 16 hours without retrimming. The above lamps are worked off a separate main; the conductors, consisting of concentric cables insulated with vulcanised India-rubber, taped and braided, and drawn into galvanised iron pipes. These mains are connected to small transformers, which transform from 2,000 to 35 volts, the latter being specially designed to fit the lamp-post bases; switches are provided to each, impedance coils are not required with this design of transformer.

The cable runs from post to post, and connects into specially designed terminals on the transformer; thus all jointing is avoided, and the cables may be quickly disconnected for testing or other purposes. Having each its own transformer, the lamps have therefore been provided with an independent supply to each, and can be turned on and off without in any way interfering with the supply to the remainder, or the whole may be switched on and off by the main switch.

Public Incandescence Street Lighting.—Gas has been superseded throughout the whole of the streets of Valetta, Floriana, and the Three Cities, by 770 32-C.P. incandescence lamps, either fitted into globe fittings with re-

flectors, and attached to brackets, or, where practicable, fixed into the existing gas lanterns.

These lamps are grouped in sections, and are worked off separate circuits, the conductors consisting of single cable insulated with vulcanised India-ruber, taped and braided, and laid upon insulators in the subways, and lead-covered twin vulcanised rubber cables laid in chases cut out of the solid rock where subways do not exist.

In all cases the conductor is led up to the lamp through wrought-iron tubing fixed to the wall of the buildings, suitable fuses being inserted in water-tight cast-iron boxes immediately underneath the lamp bracket.

The various sections are supplied by transformers from sub-chambers specially provided for this part of the work.

The distributing circuits conveying the low pressure current to the lamps are taken from specially-designed fuse-boards, mounted in cast-iron water-tight cases. There are 16 brackets fitted to eight of the arc lamp posts; these lamps are controlled by special switches, one operation putting in either the arcs or incandescence lamps as desired.

The voltage of these incandescence lamps is 37, current being taken from the arc lamp transformers; the others are run at 100 and 103 volts.

The whole of this important work has been supplied and erected by the Brush Company, while the general supervision has been entrusted by the Government to their consulting engineer, Mr. W. H. Preece, C.B., F.R.S., Mr. A. H. Preece, Mr. Marcus Chambers, and Mr. L. Gatt, C.E., the Government engineer at Malta. Mr. A. Portelli is the resident engineer.

The general design and equipment of the works has been in charge of the Brush Company's contract department, under the control of Mr. W. Geipel, M.I.E.E., their superintending engineer, assisted by Mr. S. A. Mahood as resident engineer.

BUSINESS NOTICES, &c.

Agencies.—Mr. F. Stewart, of Balmoral House, Palatine Road, Blackpool, informs us that he has been appointed the representative in that town of Mr. H. V. James, electrical engineer, &c., of Corporation Street, Manchester. We have before us a calendar published by Mr. James for 1897.

We understand that Messrs. Lloyd & Read, electrical engineers and contractors, 63, Broad Street, Bristol, have been appointed agents in that district for the "Stewart" enclosed arc lamp.

Business Announcement.—Messrs. B. Bridgwater and Co. announce that their electrical department from Nutford Place will be carried on at City Ironworks, 53, East Road, City Road.

Calendars.—Messrs. W. H. Willcox & Co. have sent us one of their "Date Remembrancers" for 1897, with a separate sheet for each month.

The National Carbon Company, of Cleveland, Ohio, has also sent a calendar, with coloured illustrations of their works.

Crompton & Co., Limited.—This company, having disposed of the lease of their premises at 1, Lillie Road, London, are transferring the manufacture of electrical cooking and heating apparatus to their new works at Chelmsford, and they have decided to cease taking orders for wiring houses in the London district. Accordingly they have disposed of the house wiring business to Messrs. Warburg, Dymond & Co., who have engaged to complete the orders now in hand, and will in future act entirely on their own account as wiring contractors. Messrs. Warburg, Dymond & Co., will for a short time have their offices at the above address, 1, Lillie Road, London, S.W. Messrs. Crompton & Co. announce that while the office and show room for general inquiries and orders for cooking and heating apparatus remains as heretofore, at 35, Queen Victoria Street, London, goods or communications relating solely to the manufacture should be sent, after March 15th next, to the new Arc Works, Chelmsford.

Dissolutions of Partnerships.—Mr. A. George Hiscock has retired from the firm of Messrs. W. G. Higgs & Co., electrical engineers, 88, York Street, Glasgow. Mr. William George Higgs continues the business.

Messrs. Sumner Smith & Gretton Mynn, carrying on business as electrical engineers and general agents at New Poultry Chambers, London, under the style of F. Sumner Smith, have dissolved partnership by mutual consent.

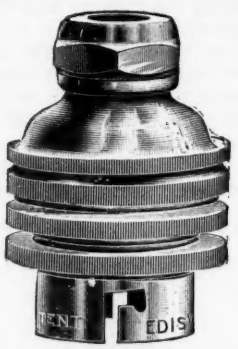
Gas.—On 10th inst., a gas explosion occurred at the Wesleyan Church, Newport Pagnell, just before the time for commencing service.

A serious explosion at the Seaton Carew blast furnaces, near West Hartlepool, on 17th inst., resulted in seven men being enveloped in flames; five had to be detained at the hospital.

Escapes of gas from a service pipe in M'Neil Street, Glasgow, rendered it impossible to live in certain houses. One of the occupants was found to be suffering from gas poisoning.

1897.—The Director-General of Telegraphs at Mexico sends a neatly-prepared card, with the compliments of the season, and we have pleasure in reciprocating his good wishes.

Lamp-holder. — The Ediswan waterproof lamp-holder, which we illustrate, is intended for outside work, such as mines, collieries, cellars, and all other damp places, The top part is now



cast in one piece in order to prevent water getting through the thread. A rubber washer clamped against the flexible cord by means of a screw nut renders the holder weatherproof. The holder is supplied by the Edison & Swan United Company.

Smoke Prevention. — Patterson's smoke-preventing suction draught system for land and marine boilers has been introduced by Messrs. Matthew Paul & Co., of Levenford Works, Dumbarton, who are the sole licensees and makers. In this system the fan, through which the products of combustion pass on their way to the atmosphere, is placed in the uptake or main flue leading from boiler to chimney. Water is sprayed from the fan centre among the hot gases, effectually protecting the fan from damage by heat, and reducing the temperature and volume of the gases, and consequently the size of fan required. The intensity of draught and steam production are easily and rapidly regulated by the speed of fan. An ordinary marine return tube boiler, with this draught fitted, has been at work for the last six months at Levenford Works. The boiler is 8 feet 9 inches diameter, by 8 feet 6 inches long, with two furnaces 2 feet 6 inches diameter, and 2¼ tubes 5 feet 6 inches long over plates. The heating surface is 545 square feet, and the grate area 15 square feet, the ratio being 36 to 1. The furnace fronts, doors and bars are of the ordinary arrangements as for natural draught. In a table of results issued by Messrs. Paul, it is shown that an evaporation has been reached equivalent to 15½ lbs. water per square foot of heating surface per hour from feed at 150° to steam at 160 lbs. pressure, with 9·9 lbs. water per pound of average Welsh coal. This is about 10 per cent. more economical than ordinary natural draught, while the rate of steaming is three times as great. The coal consumption is said to have been frequently as high as 60 lbs. per square foot of grate per hour; and under these rates of combustion and evaporation, there has not been any trouble with tube plates, tubes, or fire bars, though we understand that the boiler has been subjected to the severest treatment in raising steam quickly and in sudden increase and reduction of duty. The smoke prevention is stated to be absolute, and is attained by a proper arrangement of air admission, without complicating the furnace fittings, together with the washing of the gases by the water spray as they pass through the fan. The water supply required for fan is about double the quantity of the feed water supplied to boiler, and may be either salt or fresh. An extended trial with cooling water of double the density of sea water has proved that this has no deleterious effect on the fan structure, and there is no interference with the efficiency. With this draught one boiler will do the work of two, or even of three with natural draught, with a saving of coal and without smoke, and the apparatus can be easily adapted to any existing installation of land or marine boilers.

Stewart Electrical Syndicate Limited.—We are informed that the increasing business of this syndicate has rendered it necessary to secure larger and more convenient premises, and they will hereafter be found at No. 5, New Compton Street, Charing Cross Road, London, W.C. The new quarters will be fitted with all modern improvements, including both direct current and alternating dynamos, to generate current on the premises, and a display of the "Stewart" long-burning arc lamps and other specialities will be made.

ELECTRIC LIGHTING NOTES.

Ashton.—The design of arc lamp pillars submitted by Mr. Clirehugh has been approved by the Council. There are to be 70 of them fixed.

Battersea.—The Electric Light Committee reports having taken steps to secure certain land for the purpose of electric lighting works at a cost of £13,000. Several members have protested against the expenditure.

Belfast.—The electrical engineer has been instructed to procure and fit up the appliances rendered necessary by the change of pressure.

Bedford.—The new alternator supplied by Messrs. Easton, Anderson, and Golden is nearly ready for work. There are now four alternators at the works, but the last one is practically equal in capacity to the other three combined.

Bingley.—The Leeds and Liverpool Canal Company, having made an offer to the Council to supply them with electricity for the district, some of their water power being utilised for the purpose, a committee has been considering the matter, with the result that an expert (Mr. A. H. Gibbings, of Bradford) is to be engaged to advise as to the Council putting down its own installation, and to prepare an estimate as to the probable cost.

Bray.—Mr. Hugh Smyth has been appointed assistant electrical engineer.

Cardiff.—The Board of Guardians are to call in an expert to advise as to the cost, &c., of lighting the workhouse, surplus steam power now on the premises being employed.

Clontarf.—The Secretary to the Commissioners is to make inquiries as to the cost of lighting the township by electricity.

Country House Lighting.—Athgarvan Lodge, Curragh Camp, the residence of Mr. W. Pallin, J.P., has recently been fitted up with an electric light installation by Messrs. Edmundson & Co., of Dublin.

Cromer.—The Council last week had a discussion *re* electric lighting, and decided by 7 votes to 5 to apply for a provisional order, the principal object being to prevent a Company coming into the district.

Dorking.—The District Council has resolved, on the recommendation of the Lighting Committee, that Messrs. Edmundson, who were about to carry out the electric lighting at Reigate and other places, be invited to discuss with them the terms upon which they would be prepared to enter into an agreement with the Council, under the provisional order applied for by the latter, for lighting the district by electricity.

Dover.—St. Mary's Church is about to be lighted by electricity. Sir Richard Dickeson will pay the cost of the installation.

Dufftown.—A committee recently appointed by a public meeting has decided to invite contracting engineers to submit estimates and relative plans for a system of electric lighting. A subcommittee was appointed to confer with the engineers on their visits of inspection.

Glasgow.—The Corporation is giving notice that all persons who make application for current on and after February 18th will be supplied at a pressure of 200 volts.

Glenlivet.—Colonel Smith has introduced electric light at his shooting lodge, and at the Glenlivet Distillery, Messrs. Middleton & Co. having been engaged on the work. Developments have been carried out, and a very complete system has been made to reach every corner of the huge granaries and warehouses. An engine, dynamo, and accumulators, provide current for 300 odd lights.

Hanley.—It is proposed to borrow £15,000 for extensions at the electricity works.

Hull.—At a special meeting of the Electric Lighting Committee last week, the report of the sub-committee appointed to visit Leeds, Halifax and Bury, with respect to the new engines was presented, and after some discussion, it was adopted.

Islington.—Mr. Lambert, the chairman of the Electric Lighting Committee, reports that the profit on the revenue account for the last quarter amounts to £1,503 19s. 11d. Instalment of loan and interest were paid amounting to £682 8s. 2d., leaving a net profit for the quarter of £818 17s. 9d. The receipts for sale of current were £3,851 (£1,201 odd for public and £2,343 for private lighting). On the other side of the account are generating expenses, £1,444 odd; distribution, repairs, &c., £14 odd; public lamps, £62 10s. 4d.; rates and taxes, £163 10s. 1d.; establishment charges and maintenance, £445 4s. 2d.; and the Barnard Place property, £23 15s. 2d. Certain property in Eden Grove is to be purchased at a cost of £1,400 for extending the electric light station. This will give uninterrupted frontages along Eden Grove and Barnard Place.

Kensington.—The Kensington and Knightsbridge Electric Lighting Company, Limited, have given notice that the standard pressure for new customers is 200 volts, at which pressure all new customers have to be connected, and any existing customers can be changed over from 100 to 200 volts, on all the necessary alterations being carried out. The standard price at 200 volts is 5½d. per unit, instead of 6d. per unit at 100 volts.

Mexico.—We understand that Messrs. Siemens and Halske have obtained the contract from the City of Mexico for gas and electric lighting. It is stated that an English company which held the old contract withdrew from the competition.

Mile End.—The Board of Guardians has decided to ask those electrical engineering firms who tendered in the first instance to re-tender to the revised schedule.

Newport.—The Electricity Committee has reported that, having again considered the claim for £235 of the Uskside Engineering Company as extras in respect of engines supplied to the electric light station, and having heard Mr. A. J. Stevens, the managing director, they decided they could not entertain the claim. The company require the matter to go to arbitration.

Paisley.—The Council, on 12th inst., considered Mr. Francis Teague's (the electrical engineer) £33,750 scheme for electric lighting. It was decided that schedules be prepared by Mr. Teague, with the view of obtaining estimates, and application is to be made to the Secretary for Scotland for power to borrow the sum of £35,000.

Portsmouth.—At the last meeting of the Council, Alderman Ellis explained the causes of recent temporary failures in the supply, and moved the adoption of the Committee's recommendation to apply to the Local Goverment Board for sanction to borrow £10,000 for the purposes of extension. He gave statistics showing a gross profit of £5,587 in nine months. He estimated that in the remaining three months the income would be £4,0"8. The interest (3 per cent.) on borrowed capital, and the proportion to the sinking fund, would absorb £4,545, leaving a net profit for the year of £3,690 6s. 3d., which would be at the disposal of the Council on March 31st. Mr. Ellis added that the accumulators it was proposed to purchase would store enough current to supply the town for four hours, and there would be a saving of 50 per cent. on the cost of production. The Committee's recommendation was adopted.

River Plate.—The River Plate Electric Light Company have 60 arc lamps in the streets, and about 1,000 incandescents in shops and private residences.

Sheffield.—The Sheffield Electric Light and Power Company, Limited, have decided to reduce the price of current, as from January 1st, from 6d. to 5d. per unit. Orders have been given by the company for the delivery of new machinery of more than 2,000 H.P. before next autumn, and great preparations are being made in the engine room for its reception, and for the laying down of new supply cables in the residential and other districts.

Southport.—A Local Government Board inquiry was held on 16th inst. regarding the application of the Corporation for power to borrow £12,000 for electric lighting extensions.

Taunton.—The boiler at the central station, to which we referred last week, has been repaired at a cost of £13 odd.

Wallasey.—The Electric Free Wiring Syndicate, Limited, which has secured the contract with the District Council for the supply of wires and fittings, has opened premises at 82, King Street, Egremont, where is kept a large stock of electric fittings.

Walsall.—The number of consumers supplied on December 31st last was 76. The total units generated at the station during the month of December was 19,284. The total output from the main generators was 18,050 units. The total units for the transformers was 14,313. The total units registered on the meters was 11,715.

Walton-on-Thames.—The application of the Walton-on-Thames Electric Lighting and Power Company, Lmited, for a provisional order occupied the attention of the Council last week. The Council decided to ask the Board of Trade to increase the company's deposit to £1,000.

Whitehaven.—The electric light buildings and plant have been insured with the Royal Insurance Company.

The relaying of the public lighting cables has been completed, and it is stated that during the last month there had not been a single fault.

Willesden.—The proposal of the Hampstead Vestry regarding the lighting of Kilburn High Road was before the Willesden Council on 12th inst., and was referred to a committee.

Winchester.—A company has been formed here with a nominal capital of £25,000, in £5 shares, to be known as the Winchester Electric Lighting and Power Company, for the purpose of taking over (through Messrs. Edmondsons, Limited) the provisional order, dated June 27th, 1895, and granted by the Board of Trade to the Winchester Corporation for the purpose of electric lighting in the city. The directors are Major-Gen. Montgomery, Capt. Clayton Mitchell, Mr. T. F. Kirby, Mr. A. R. Dyer, and Mr. F. E. Gupper.

Wycombe.—It is stated that the Electric Lighting Committee, after examining alternative proposals, recommend the Corporation to complete the agreement with Messrs. Pritchetts & Gold (or the High Wycombe Electricity Supply Company).

Yarmouth.—During the past month five customers had been secured for 139 more lamps, so that there are now 200 customers, using 9,868 lamps. The month's receipts were £453 13s. 4d., and the expenditure £205 0s. 6d., a balance of £248 12s. 10d. being left to meet capital and sundry charges of £150 per month.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Buenos Ayres.—A new electric tramway from Buenos Ayres to Flores and the Floresta is nearly completed. The cars are supposed to be running by April 1st.

Calcutta.—As our readers are aware Calcutta has been occupied with the tramway question, the result of consideration being favourable to delaying the scheme. *Indian Engineering*, for December 26th, has a leading article on this subject, and comes to the conclusion that the best thing to be done is the adoption of some form of electric traction combined with an electric lighting scheme. Our contemporary recommends that tenders for such combined plant be invited.

Dover.—The tenders submitted for laying the permanent way for the electric tramways was as under. The surveyor's estimate was £12,700.

	£	s.	d.		£	s.	d.
No. 1.	12,470	15	10	No. 8.	14,927	16	9
2.	11,794	0	0	9.	12,738	3	9
3.	12,719	19	7	10.	13,499	1	4
4.	14,820	0	0	11.	13,570	13	0
5.	8,921	14	7½	12.	11,594	17	1
6.	13,499	0	0	13.	14,600	0	0
7.	11,796	13	7	14.	13,162	14	7

It was resolved not to divulge the names of the tenderers. On the recommendation of the consulting engineer, it was agreed to engage Mr. R. W. Blackwell to carry out the electrical bonding of the rails at a cost of £900. The tenders for the supply of steel rails, &c., were next opened, the surveyor's estimate being £4,900. The successful tenderer's were Messrs. Rowell, Stewart, Kelman & Co., of Old Broad Street, London, £5,177 19s. 8d. The other tenders were:—Mr. J. W. Scott, Victoria Street, London, £5,186; Leeds Steel Works, £5,730 10s.; Kerr & Co., Glasgow, £5,308 4s. Two other tenders were informal.

Dundalk.—An official inquiry was held at Dundalk on January 12th, by Mr. R. Haire, Board of Works Inspector, to enquire into the engineering merits and objections (if any) to the scheme of the Dundalk and Blackrock Electric Tramways Company. Mr. J. H. Ryan, M.Inst.C.E., gave evidence on behalf of the Development Syndicate (Ireland), Limited, the promoters of the project, which was also represented by Colonel Dickenson. Mr. Ryan, having explained the route and engineering features at some length the meet-approved unanimously of the undertaking.

Electric Lift.—Messrs. Easton, Anderson & Goolden, Limited, are now erecting a lift to carry 15 passengers at the Kelvin Bridge Station of the new Glasgow District Subway. It will be worked by electricity with continuous current, and will be fitted with improved safety gear, automatic stops, and other accessories of the makers' latest designs.

Grimsby.—The Grimsby Corporation has decided to lodge a formal objection to the application for a provisional order by the Grimsby Tramway Company authorising extensions into Cleethorpes, and the use of electricity, the overhead system being intended. It was further pointed out that within about five years' time the Corporation would have power to compulsorily purchase the tramways, and if they purchased they might be saddled with unnecessary expense. It was therefore decided to add this as an additional reason for the Corporation's objection.

Stockton.—At a special meeting of the Stockton Corporation lask week the committee submitted a large number of objections to the proposed new electric tramways scheme from Stockton to Middlesbrough, which were adopted. Amongst the chief was objection to the overhead trolley system in the High Street, and stipulating that the Corporation should have the option of purchasing the trams in 1,901.

Swansea.—The Corporation at the last meeting resolved to petition against the Bill intended to be promoted in the next session by the Swansea Improvements and Tramways Company to authorise them to equip the tramways with electricity.

The City and South London.—This line is made the subject of considerable vituperation by some of its passengers, but it would appear that the Vestry of Camberwell views it with great appreciation, for it has appointed a deputation of 12 of its members to urge upon the company the necessity of extending their lines from St. George's Church Station, Borough, down Great Dover Street, Old Kent Road, Trafalgar Road, Sumner Road, Victoria Road, Ady's Road, Crystal Palace Road to the "Plough," Lordship Lane. The Vestry even goes so far as to advise, free of charge, as to the best positions for stations.

Various Methods of Tramway Working.—We have received from the British Electric Traction Company, Limited, an instructive little pamphlet on various methods of tramway working with special reference to electric traction. Some interesting facts about the different systems are given which ought to prove easy of digestion to the average town councillor.

Worcester.—The Corporation Streets Committee have decided, says *Daily Tenders*, to recommend the Council not to sanction the extension of the tramways along High Street in view of its narrowness, but to consent to the proposed extensions to Red Hill, Cherry Orchard, and Rainbow Hill. The committee also recommend that if electricity be used as the motive power, the Tramways Company shall obtain the current from the Corporation works.

Yarmouth.—On 12th inst. the Corporation discussed the scheme of electric tramways for Yarmouth proposed by the British Thomson-Houston Company, and an amendment disapproving of the proposal and refusing sanction was passed. On the requisition of five members, however, another meeting was held on Monday when Alderman Suffling moved a resolution to rescind the resolution and granting sanction. He stated that the promoters had been led to expect by the action of the Council that its sanction would be given to their scheme, and in that belief they had gone to an expenditure of several hundred pounds. The pecuniary result to the Corporation, if the undertaking was sanctioned, would be a profit of £1,600 per annum, and without this it would apparently be a long time before the electric light works would show a profit. It was urged by opponents of the scheme that the Corporation might be induced to make a capital outlay of £5,000 for electric plant, and then, if the scheme failed, the Corporation would be a loser to this extent. But under the conditions the promoters had to deposit with the Corporation a guarantee of £2,000, while they were bound to take at least £2,500 worth of electric power per annum. Therefore in a year or two's working the Corporation would be re-imbursed for its capital outlay. Moreover, the provision of this plant would enable electric power to be supplied to the town, and the extension of this department might lead to the public being supplied with it at 3d. per unit instead of 6d. Of course the promoters were intending to make money by the scheme, and they would be very foolish if they did not. As to the opposition of the cabmen, he maintained that they could not cater for a class. If they did not carry the resolution he had to propose they would, he was confident, be retarding the progress and prosperity of the town. Mr. E. W. Worlledge, seconding, retraced the history of the question in order to show that there was ample justification for the Council now altering its opinion. The Lands Committee approved the scheme when first proposed, and so also did the Council. In the early stages the opposition was so practically nil that the promoters took all the needful preliminaries for the obtaining of a provisional order. It was now too late to raise objections, having regard to the original resolution which was carried by the Council. He understood that the actual expenses incurred by the promoters were—in London £400, in Yarmouth £65, Mr. Preece's fee £55, and other expenses in London and Yarmouth £150, a total of £670. Mr. F. Arnold moved as an amendment that consent be withheld from the proposed scheme until the surveyor had reported upon the feasibility of the Corporation establishing and working tramways itself. He was in favour of tramways, but all over the country municipalities were acquiring the tramways, and he could not help thinking this was the line the Corporation should adopt. Mr. T. Green seconded the amendment. On the amendment being put there were 23 for the amendment and 11 against. It was therefore carried, and sanction is refused accordingly.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Maranham-Ceará	Dec. 2nd, 1896 ...	...
St. Croix-Trinidad	Nov. 30th, 1896 ...	...
Mozambique-Lorenzo Marquez	Dec. 24th, 1896 ...	...
Hong Kong-Macao	Jan. 5th, 1897 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Salisbury-Umtali	July 11th, 1896 ...	...

December 5th, 1896.—Katarina-Larissa route working badly.

On February 1st next the equivalent of one franc will be increased by the Portuguese Administration to 260 reis.

The administration of Servia on February 1st will reduce the transit rate for Bulgarian correspondence (European system) to 3 centimes.

Brussels-Berlin Telephone Service.—The German Government is stated to have approved of the construction of a telephone between Berlin and Brussels, but the work will not be begun until the credit is voted by the Reichstag. Berlin is already connected by telephone with Amsterdam.

Glasgow Telephones.—A deputation from the National Telephone Company waited, on 15th inst., on the Statute Labour Committee of Glasgow Corporation to ask permission to lay the wires underneath the ground. The deputation were asked to submit their application in writing.

The Trunk Telephone Service.—The Postmaster-General has replied, in a letter dated the 18th inst., to the memorial recently addressed to him by the Liverpool Chamber of Commerce, complaining of inefficiency in the trunk telephone service between Liverpool and other large towns, and the consequent delay in communication. The Postmaster-General states that the efficient working of the trunk wires is engaging his earnest attention, and every effort is being made to ensure a satisfactory service. In 1892, he proceeds, Parliament set aside a million sterling for the purchase of the trunk lines of the National Telephone Company, and the construction of new lines, and this sum was increased last year by a further £300,000. Very considerable progress has been made in the erection of new lines; and, of two additional circuits from Liverpool to London, one was completed on Monday, and the other is well in hand. Eight to Manchester are partly finished and partly in progress. Lines to Bolton, Cardiff, and Leeds are being erected as rapidly as possible. At the same time, improvement is being studied as to communication between Liverpool and Sheffield, Birmingham, Bristol, and Blackburn. As to the extension of the three minutes allowed for conversations, the Postmaster-General cannot meet the views of the memorialists, nor can he comply with the wishes of certain firms to rent private wires between Liverpool and London, nor to introduce a system of limiting the use of a trunk wire to particular firms. The

Department, however, is erecting additional telephone wires from London to the North, and an underground line to Birmingham is being constructed, to which the telegraph circuits will be gradually transferred, so as to leave the existing overground route available for telephoning. This last work, the Postmaster-General adds, will be undertaken forthwith, but it will be one of great magnitude, and must occupy several years.

CONTRACTS OPEN AND CLOSED.

OPEN.

Derby.—February 6th. The Corporation wants tenders for electric wiring and fittings for the new Municipal Technical College buildings. See our "Official Notices" for details.

Edinburgh.—January 28th. The Managers of the Royal Infirmary are inviting tenders for the complete wiring of the Infirmary buildings. Particulars from the treasurer and clerk (Mr. W. S. Caw), or Prof. Kennedy, 17, Victoria Street, S.W.

France.—January 28th. The French Post and Telegraph Authorities in Paris are inviting tenders for the supply of 6,000 galvanised iron screws, and 25 tons of bronze wire. Tenders to be sent to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

France.—January 31st. Tenders are being invited until January 31st next, for the contract for an installation of electric lighting in the Asile d'Aliénés at Saint Jvon (Seine Inférieure).

Hull.—February 1st. The Corporation of Hull is prepared to receive tenders for a lease of the tramways authorised to be constructed by the Tramways Orders Confirmation (No. 1) Act, 1,896.

Jamaica.—April 15th. The Privy Council invites applications for a license for the establishment and working of a system of rapid transit in Kingston and environs. Copies of the Tramways Law, 1895, and of local rules and maps of Kingston and environs may be seen at the offices of the Crown Agents for the Colonies, London.

St. Pancras.—January 26th. The Vestry wants tenders for supplying and laying earthenware conduits, lead covered armoured cables, and bare copper strip conductors in culverts. Particulars at the Electricity Department Offices, 57, Pratt Street, N.W.

Wallasey.—February 18th. The District Council invites tenders for the supply and erection of a 200 kw. alternator with engine combined and for the requisite switchboard extensions. Particulars on application to the engineer, Mr. J. H. Crowther, the Great Float, near Birkenhead.

CLOSED.

Austria.—The contract for the conversion of the tramway between Vienna and the suburb of Baden into an electric line has been placed with Messrs. Schuckert & Co., of Nuremburg, Germany.

Bury.—There were a number of tenders submitted for the electric wiring of the Municipal Offices for the Corporation. The contract was carried off by Messrs. H. H. Woods & Co., of Blackburn. Among those who tendered were the following:—Paterson & Cooper; Electrical Installation Co.; Birmingham Installation Co.; Marr Electric Co.; F. Saunders & Co.; Coates Bros.; J. Downham; T. Cornall; E. M. Evans; S. H. Heywood; Welch & Co.; Shaw & Co.

Dundee.—The Directors of the Royal Lunatic Asylum have accepted the following tenders for an electric lighting installation at the Asylum and Gray House:—Lowdon Brothers, Dundee, £2,281 17s.; M'Farlane, Machan & Co., Dundee, £265; J. Maxwell and Son, Dundee, £501 15s.

Southampton.—On the recommendation of the Electric Lighting Committee, the Council have accepted the following tenders:—Messrs. W. T. Glover & Co., for the supply of high tension concentric cables; the Fowler Waring Cables Company, Limited, for high tension twin cables (armoured and unarmoured), and for low tension single cables; Messrs. Reid Bros., for supplying and laying earthenware conduits and for drawing-in-boxes, subject to the necessary alteration in Messrs. Reid's design for drawing-in-boxes being made to Mr. Manville's satisfaction. The resident engineer (Mr. J. H. Lee) reported that during the past month there had been an increase of 8 per cent. in the number of units sold compared with the corresponding period of last year.

Röntgen Rays.—In this year's estimates for the kingdom of Prussia a sum of 50,000 marks is, a daily paper says, provided for assisting institutions and certain private individuals to obtain the necessary apparatus for investigations with the Röntgen rays. This sum is divided into two parts—for the purchase of apparatus and for working the same. A Röntgen apparatus complete costs about 2,500 marks (£125) in Berlin.

NOTES.

The Brush Electrical Engineering Company, Limited.—We are officially informed of the following changes in the management of the Brush Electrical Engineering Company:—Mr. J. S. Raworth, whose time is now almost entirely devoted to the development of the "Universal" steam engine, has resigned his position as joint manager and chief engineer, and has been appointed consulting engineer, and elected a director of the company. Mr. W. M. Mordey, who for many years has been chief electrician, will in future act as consulting electrician to the company, and will be free to undertake other work; the company, however, retaining his advice and assistance with regard to the articles of his design and invention which it manufactures. Mr. Percy Sellon, lately joint manager with Mr. J. S. Raworth, has been appointed general manager of the company, and Mr. C. E. Hodgkin works manager at the Loughborough Works.

The Pound and Poundal.—A correspondent, "R. C.," sends us the following note of a fallacy about the value of π, which may amuse some of our readers:—"As practical men are sometimes interested in 'π' as well as in 'g,' perhaps the following method of determining its value may not be out of

place:—The area of the semi-ellipse B A D $= \frac{1}{2} \pi a b$, and this is true even if the centre, C, moves off to a great distance; in which case it becomes a parabola, and its area $= \frac{2}{3}$ of its circumscribing rectangle:

$$\therefore \tfrac{1}{2} \pi a b = \tfrac{2}{3} \cdot a \times 2 b,$$
$$\therefore \pi = 2\tfrac{2}{3}."$$

Copper in 1896.—We make the following extracts from Messrs. James Lewis & Son's report:—

The year 1896 has been notable for an enormous increase in the European consumption of copper, concurrently with a considerable decrease in the consumption of the United States, the former amounting to about 55,000 tons, or 42 per cent. increase over that of 1895, and the latter to nearly 11,000 tons, or over 11 per cent. decrease below that of 1895. Notwithstanding an increase of 33,427 tons, or 20 per cent. in the production of the United States, this excess, in addition to their reduced home consumption of 10,865 tons, has been readily absorbed by Europe, the public stocks in England and France being also encroached upon to the extent of 11,640 tons, reducing them from 42,917 tons on January 1st, to 31,277 tons on December 31st. The effect upon the value has been to advance it to the extent of fully £8 per ton—from £41 7s. 6d. for good merchantable copper on January 2nd to £49 10s. on December 31st, £40 10s. being meanwhile reached on January 7th, and £50 7s. 6d. on June 15th. With regard to the future value of copper, we consider that the present level of prices is likely to be maintained, if not exceeded. There is every probability that European consumption will be larger this year than last. For electric traction much copper will be required, as already application has been made for provisional orders for 28 different light railroads, representing 300 miles of road. There is much agitation for an extension of the long distance telephone system. The use of electric light is increasing. With a continuance of the present cheapness of money in the United States, electric lighting, power and tramway and telephone companies will be greatly extended, as the sale of their bonds will be much facilitated, resulting in a considerable increase in the American consumption of copper.

The Northern Society of Electrical Engineers.—The following is a list of the officers and Council for 1897:—

President—Mr. C. M. Dorman.

Past Presidents—Dr. John Hopkinson, F.R.S., Mr. Henry Edmunds Mr. W. P. Jas. Fawcus.

Vice-President—Mr. S. Z. de Ferranti.

Members of Council—

Mr. C. H. Wordingham.	Mr. E. A. Claremont.
Mr. E. Manville.	Mr. A. B. Mountain.
Mr. C. S. Northcote.	Mr. James Taylor.
Mr. Thomas Browett.	Mr. S. V. Clirehugh.
Mr. E. W. Cowan.	Mr. G. H. Nisbet.
Mr. G. S. Corlett.	Mr. G. W. Lowcock.

Hon. Solicitor—Mr. John B. Parkinson.

Hon. Treasurer—Mr. A. Eckstein.

Hon. Secretary—Mr. John Darney.

Secretary—Mr. E. E. Johnson.

Personal.—Mr. Rankin Kennedy has been appointed consulting engineer for the electric light and power works connected with the new factory and warehouses of Messrs. J. & W. Campbell & Co., of Glasgow; the whole concern is to be lighted, and the machinery all driven by electricity, about 400 H.P. being required in all. Six years ago Messrs. Campbell's factory in Leeds was similarly fitted out by Mr. Kennedy, and the transmission of power there has given entire satisfaction during the interval.

Mr. J. C. Lamb, C.B., C.M.G., has been appointed second secretary of the Post Office, and Mr. John Ardron has been appointed an assistant secretary. Our hearty congratulations to both gentlemen on their respective promotions!

Mr. Alfred Bottomley, of 46, Albion Street, Leeds, who has just returned from the Rand, has been appointed sole agent in this country for Messrs. Swete & Baker, electrical engineers, of Johannesburg.

Mr. Pink's Resignation.—The resignation of Mr. Pink, to which we referred last week, was accepted by the Council, and three months' salary given in lieu of notice. Mr. Fuller, an assistant of Mr. R. Hammond, has charge of the station pending the appointment of a successor to Mr. Pink. It is stated that a member of the Council will move that the Town Council advertise for an electrical engineer to take charge of the works, advise as to and carry out all extensions, and that Mr. R. Hammond's services as consulting engineer be limited to, and terminate with, the completion of existing contracts.

Mishap.—Several of the daily papers have stated that there was a fire on the premises of the Crystal Palace District Electric Supply Company, Limited, on 15th inst., doing considerable damage. We are, however, informed that there was no fire, but two of the coils of the armature of one of the motor dynamos at the Westow Hill sub-station broke down, producing the usual effects, which were mistaken by certain bystanders for a fire. The burning was confined to the coils of the armature, the rest of the machine being intact; no interruption in the supply was experienced, and the damaged armature was replaced well within 24 hours.

Obituary.—We deeply regret to announce the death of Mr. John Aylmer, M.I.E.E., which took place on the 18th inst., at his residence in Paris, after a long illness. About 1861, Mr. Aylmer, who was then 20 years of age, joined the firm of Messrs. Siemens & Halske, where he was associated with the late Louis Schwendler and the late Robert Sabine. For some ten years he was engaged in electrical testing, the erection of telegraph lines, chiefly in Spain, and assisting in the laying of submarine cables, but in 1871 he settled in Paris as an electrical engineer, and as foreign representative of the late Sir Charles Wheatstone, whose automatic fast-speed telegraphs he introduced into France, Italy, Russia and Spain. He took in hand the organisation of the British section of the 1881 Paris Electrical Exhibition; in 1883 he was one of the English representatives at the International Congress on standard electrical units; he took an active part in the organisation of the British section in the great Universal Exhibition held in Paris in 1889, and at the 1890 meeting of the International Telegraphic Conference, Mr. Aylmer represented the Colonies of New Zealand and New South Wales, and for years past he had acted as hon. secretary in France for the Institution of Electrical Engineers. His demise will be keenly felt on both sides of the Channel, for many electricians, French and English, to whom he had endeared himself, will mourn the loss of a true guide, philosopher, and friend.

The death is announced of Mr. George Garden Nicol, who was one of the founders with Sir John Pender and Sir James Anderson of the Eastern and Eastern Extension Telegraph Companies. He was also a director of various other companies.

Electric Light in Collieries.—We learn that the Ocean Colliery Company, one of the largest in South Wales, have purchased for use in their pits about 10,000 electric hand lamps, which can only be opened by means of special apparatus. Other extensive colliery owners in the same district also contemplate the use of similar lamps, instead of the Davy pattern.

The Institution of Junior Engineers.—The members of this Institution will, on Saturday, January 30th, at 3 p.m., visit the Lion Brewery, Belvedere Road, Lambeth.

The Institution of Electrical Engineers.—On Thursday, January 28th, 1897, a paper on "Electrical Interlocking the Block and Mechanical Signals on Railways," will be read by F. T. Hollins, member.

Change of Address.—All communications for Mr. H. W. Sullivan (inventor of the "Universal" galvanometer) should in future be addressed to 19, Great Winchester Street, E.C.

The Northern Society of Electrical Engineers.—On Monday next, January 25th, 1897, a paper on "Alternate Current Switch Gear" will be read by Mr. L. Andrews, of Hastings.

Prof. Waller on Animal Electricity.—Prof. Waller, F.R.S., commenced a series of Fullerian lectures at the Royal Institution on Tuesday last. The Fullerian Professor has selected for his subject "Animal Electricity," and, no doubt, existing knowledge will be materially added to by what Prof. Waller has to say during the course of 12 lectures, which will last from January 19th to April 6th. The lecturer commenced with an elaborate consideration of the nerve, and we were given to understand that the nerve could be alive although taken from a dead animal. One was in reality working on living matter. Then the nerve made its bow to the audience by appearing on the screen. It was not an impressive looking object, and was throughout the discourse referred to by the lecturer as a wretched little tag of nerve. Then we had two new definitions put forward by the Professor, which are going to do duty throughout the lectures, namely, zincative and zincable for positive and negative. He said that the spot in the nerve which is disturbed, or in which there is chemical action, would be termed zincative, while the spot which was at rest, or in which there was less chemical action, would be termed zincable. The Professor then took a 24-hour old nerve, which we were informed had been taken from a cold blooded animal, and it evinced its vitality by making the galvanometer kick. Extreme rapidity in recovery characterised the nerve; the nerve centres themselves might get tired and take time to recover, but the nerves themselves recovered with extreme rapidity. The nerve was then shown under ether, and by an interesting series of diagrams, the lecturer clearly demonstrated that after the period of rest or suppression, *i.e.*, when the action currents were temporarily suppressed, there followed a period of greater excitability than had existed before the temporary suppression. Prof. Waller passed on to make a comparison between a metal voltaic cell and an animal voltaic cell. The direction of current in the nerve was similar to that of the voltaic cell in that the current travels from the normal or uninjured portion of the nerve to the injured part. The action of anæsthetics upon nerves was next considered, and from the effect they could get an idea of the relative action upon the living man, provided one exercised criticism and judgment in the conclusions which were formed. Anæsthetics (ether and chloroform) temporarily suppressed the action currents; that is, there was an abolition of excitability. By means of diagrams, the lecturer showed that suppression by chloroform was more prolonged than suppression by ether, and was frequently final—*i.e.*, not followed by recovery. The suppression period of ether was shorter, and was frequently followed by secondary augmentation. The effects of ethyl bromide and ethyl chloride upon the nerves were then briefly touched upon.

NEW COMPANIES REGISTERED.

Indian Electric Company, Limited (50,882).—Registered January 15th with a capital of £1,000, in £5 shares, to carry on in the Empire of India, or elsewhere, the business of an electric light and power company in all its branches. The subscribers (with one share each) are: J. F. Albright, Mansion House Buildings, E.C., engineer; R. E. Crompton, Mansion House Buildings, E.C, engineer; F. R. Reeves, Lochleven House, Finchley, electrical engineer; H. Walker, Mansion House Buildings, E.C., electrical engineer; K. A. S. Moncrieff, 4, Fairlie Place, Calcutta, electrical engineer; E. D. Kilburn, 28, St. Mary Axe, E.C., merchant; H. F. Brown, 28, St. Mary Axe, E.C., merchant. Registered without articles of association by Deacon & Co., 9, Great St. Helens, E.C.

Winchester Electric Light and Power Company, Limited (50,868). — Registered January 14th, with a capital of £25,000 in £5 shares, to carry on the business of an electric light and power company, electricians, mechanical engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with 40 shares each) are:—C. Mitchell, Captain R.N., West Highlands, Winchester; H. F. Montgomery, Major-General, 35, Southgate Street, Winchester; T. F. Kirby, 46, Christchurch Road, Winchester, barrister; T. Slopher, Fair Lea, Winchester, architect; W. D. Gibbs, 31, High Street, Winchester, chemist; A. R. Dyer, Palm House, Winchester, merchant; F. E. Gripper, 19, Gt. George Street, S.W., electrical engineer. The number of directors is not to be less than five nor more than seven; the first are Major-General Montgomery, Captain C. Mitchell, T. F. Kirby, A. R. Dyer, and F. E. Gripper; qualification, £200; remuneration, £250 per annum divisible. Registered by C. Doubble, 14, Serjeant's Inn, E.C.

CITY NOTES.

The Reports for 1896.

THE first harbingers of spring, in the shape of two electric lighting companies' reports, are to hand, the Yorkshire House-to-House Electricity Company, and the Cambridge Electric Supply Company. We do not propose to compare the two accounts in any way, but it is worth while recording that both concerns have had a much more prosperous year than they had in 1895. As the normal condition of electric lighting stations is one of steady growth, this is only as it should be, but at the same time it must be gratifying to those that have persistently held that it was only a matter of time for electric lighting companies to show sound business. The net result of the year's work is that the Cambridge Company are paying a dividend of 5 per cent. against 3½ per cent. paid last year, and the Leeds Company are declaring a dividend of 6 per cent. on the year's work against 5 per cent. for the previous year. The dividends that have, up to the present time, been declared on the ordinary shares for the year 1895, are as follows:—

	1895.	1896.	Increase.
St. James's and Pall Mall Electric Lighting Company	7¼	10½	3¼
Cambridge Electric Supply Company	3½	5	1½
Yorkshire House-to-House Company	5	6	1
Coventry Electrical Tramways Co.	—	8	—

It is natural that investors should have taken some interest in at least one of these concerns, and the present value of St. James's shares stands at 13—14, against 8¼—9 at this date last year.

We will now deal with the companies' reports separately, taking first that of the Cambridge Company.

Cambridge Electric Lighting Company.

DURING the year 1896 there has been added to the company's mains the equivalent of 3,973 8-candle-power lamps, making the total 18,633. The number of units supplied has been 197,615, against 150,510, an increase of 47,105, or 31 per cent.; the total cost of coal has been diminished by 6⅔ per cent. Forty new consumers have been added, making the total 287.

The capital expenditure for the past year has been £2,584 2s. 9d., against £5,690 2s. 6d. for 1895; the number of lamps, however, connected during 1896 is in excess of 1895. The company has very largely benefited by the new machinery and sub-stations which were added 14 months ago.

The 220 yards laid down in the year brings the total of main conduit pipe and cable to 13,271 yards. The conversion of the high tension house-to-house supply to low tension, three wires at 210 volts, has been steadily proceeded with. A new public sub-station at the theatre has been constructed, and the capacity of the existing ones largely increased; of the total demand, 53 per cent. is now supplied through sub-stations, and thereby a considerable saving is effected.

The company has made a profit on the year's working of £2,492 16s. 9d., which, added to £63 4s. brought forward from last year, makes £2,556 0s. 9d., and after paying £112 15s. 2d. interest on debenture capital, there remains a balance of £2,443 5s. 7d. The directors, therefore, advise the payment of a dividend of 5 per cent., of which £654 16s. 1d. has already been paid as interim dividend, absorbing £1,738 17s. 11d., leaving £704 7s. 8d. for depreciation, directors' fees, and carrying forward.

It is certain that the most discontented shareholder ought to be somewhat mollified by the foregoing report. If one had the necessary figures, it would have been interesting to see what difference had been made in the day losses by the adoption of the sub-station system for house transformers; but no doubt when the Board of Trade accounts are made out, it will be possible to gratify our curiosity. We must also wait for these accounts before we can attempt to analyse the cost of production, though we notice that the coal figure has been materially reduced.

Coventry Electric Tramways pay 8 per cent.

The directors of the Coventry Electric Tramways Company have just issued a most interesting report for the year 1896. The company have carried 1,000,196 passengers, and the cars have traversed 215,000 miles, the net profit being £2,584. After paying debenture and preference interest, a dividend of 8 per cent. is recommended on the ordinary shares, carrying forward £912. All the capital of £25,000 is paid up. The company have a Bill in Parliament this Session asking for power to build a great extension system, which will practically cover the whole city, and which none of the local authorities affected seriously oppose.

The Leeds Figures.

Although the report of the directors of the Yorkshire House to House Company is full of interest, we venture to think that the majority of electrical men will be mostly concerned in the strikingly low cost of production which has been obtained at Leeds during the year 1896. It will be remembered that the works' cost for the previous year excited a good deal of comment, for with one exception they proved to be the lowest in the country. Whether other 1896 accounts will show us any lower costs of production than those given by the Leeds accounts is difficult to say at the moment. Mr. Dickinson has so far improved upon his excellent figures of 1895 as to bring the works cost from 1·45d. down to 1·24d., and the total cost of production from 2·06d. down to 1·65d. It is a most creditable performance, and one most difficult to equal.

The following are the principal points in the directors' report:—

"The profit for the year, after transferring £3,000 to the depreciation fund account, amounts to £6,960 0s. 5d., to which is to be added the sum of £517 16s. 4d., brought forward from the previous year, making a total of £7,477 16s. 9d., which the directors propose shall be appropriated as follows:—

	£ s. d.	£ s. d.
To Reserve fund account		2,500 0 0
„ Payment of interim dividend at the rate of 5 centum per annum upon the ordinary shares of the company, made for the half-year ending June 30th, 1896	1,652 14 9	
„ Payment of a dividend at the rate of 7 per centum per annum on the same shares, for the half-year ending December 31st, 1896, on the amount called and paid up thereon, making 6 per cent. for the year	2,932 9 10	
		4,585 4 7
„ Balance to carry forward to next account		392 12 2
		£7,477 16 9

"The company's works and plant have been maintained in a thoroughly efficient state of repair.

"The number of lamps connected to the mains, which, on December 31st, 1895, was equivalent to 32,539 35-watt lamps, had increased by December 31st, 1895, to 39,396 such lamps.

"Contracts were made in the early part of the year for the erection of extensive additions to the company's buildings, and for the supply of engines, boilers, and other plant, representing an increase of 1,000 indicated horse-power (or 600 kilowatts) in the capacity of the works, and involving an expenditure of upwards of £35,000.

"It was expected that the new plant would be running in time to meet the present winter's demand, but the recent strike in the building trade, extending over 20 weeks, rendered this impossible. Owing to this delay the directors have been compelled to refuse the applications of many intending consumers, otherwise the increase in number of lamps connected, and in sales of current, would have been larger.

"As reported verbally at the last general meeting, the company has purchased the Britannia Mills Estate, comprising 5,700 square yards, immediately adjoining the present works. In the event of further extensions being necessary, this purchase will prove very advantageous, and in the meantime the bulk of the property is let.

"The mortgage for £6,000 on the land and buildings occupied by the company has been paid off.

"The contracts and purchase above mentioned necessitate a further increase of capital, and as all the company's present authorised capital is issued with the exception of 1,052 shares, the shareholders are asked to increase the capital of the company by the creation of an additional 20,000 ordinary shares, bringing the capital up to £200,000."

It is necessary to explain that in our analysis of the cost of production there is no charge included for rent, rates and taxes, the rents receivable standing at a much higher figure than the disbursements for rates, taxes, &c.

	1896.	1895.
Total capital invested ... ... —	£105,377	£76,020
Number of units sold ... ... —	701,409	524,629
Number of lamps connected ... —	39,396	32,539
Revenue from sale of current, &c. —	£14,728	£11,274
Net revenue ... ... —	£7,475	£6,780
Average price obtained p unit —	—	5·1d.

Cost of production.	£	Per unit.	1895.
Coal	849	·29d.	·30d.
Oil, waste, water and engine room stores	211	·07d.	·16d.
Salaries and wages at generating station	1,927	·66d.	·80d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	652 {Works' cost 1·24d.}	·22d.	·19d.
Rates and taxes	—	—	·03d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	1,190	·41d.	·57d.
Depreciation of buildings and plant account	—	—	—
Renewal fund account	—	—	—
Total	£4,829	1·65d.	2·05d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current .. .. .. Meter rents .. .. Sale of lamps	14,728	0	0	—
Total	£14,728	0	0	

Total cost per unit (exclusive of depreciation and renewal accounts), 1·65d.; works' cost, 1·24d.

City and South London Railway Company.

THE report of the directors, with statement of accounts for the half-year ending December 31st, 1896, to be submitted to the half-yearly ordinary general meeting of the company, to be held at Winchester House, Old Broad Street, in the City of London, on Thursday, January 28th, 1897, at 12 o'clock noon, states that the receipts from all sources for the past half-year have amounted to £26,282 4s. 6d., and the cost of working has been £14,930 1s. 11d., leaving a profit of £11,352 2s. 7d. Inclusive of the balance brought forward from June 30th last, the net revenue account shows an aggregate total of £12,559 9s. 1d. After making provision for the debenture and debenture stock interest, a balance remains available for dividend of £8,930 16s. 6d. Out of this sum your directors recommend that the full dividend of 5 per cent. per annum be paid on the preference, and that a dividend at the rate of 1¾ per cent. per annum be paid upon the consolidated ordinary stock, leaving a balance of £1,313 11s. 6d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

Half-year ended	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets). £	s.	d.
December 31st, 1890 (11 days)...	165,000	1,568	3	9
June 30th, 1891	2,412,343	19,403	6	9
December 31st, 1891	2,749,055	19,798	16	6
June 30th, 1892	2,813,162	20,931	4	2
December 31st, 1892	3,117,602	22,002	17	5
June 30th, 1893	3,146,656	22,458	6	9
December 31st, 1893	3,093,351	22,067	14	10
June 30th, 1894	3,383,154	23,564	10	6
December 31st, 1894	3,275,649	23,540	12	4
June 30th, 1895	3,113,199	23,711	5	8
December 31st, 1895	3,172,438	23,780	3	7
June 30th, 1896	3,192,672	24,021	13	0
December 31st, 1896	3,368,480	25,567	7	6
Total since the opening of the line	37,002,761	£272,416	2	9

The new condensing plant is completed, and working satisfactorily. The further sum of £6,900 has been paid off the 5 per cent. terminable mortgage debenture bonds during the past six months. The Bill for the Extension of Time for the construction of the line to Islington gave rise to much discussion and difference of opinion between the two Houses of Parliament in reference to the removal, or otherwise, of St. Mary Woolnoth Church. Eventually the Bill was passed, retaining the clauses inserted by the House of Commons, the general effect of which was to give power to construct a station on the site outside, and underneath the church, provided the fabric of the church itself was preserved. Plans for carrying out the works under these altered conditions have been prepared, and are now under discussion with the authorities. The sites for the stations at London Bridge and Finsbury Pavement have both been acquired, and at the former the works are now in progress. The tender of Messrs. J. Mowlem & Co. for the construction of the tunnels and stations has been accepted, and they have commenced work. Your directors have to record with great regret the death of Mr. J. H. Greathead, who has been the engineer of this company from its commencement, and under whose supervision the construction of the line was so ably and successfully carried out. In consequence of Mr. Greathead's death it was necessary to appoint another engineer to carry out the works now in progress, and your directors have great satisfaction in being able to report that Sir Benjamin Baker has consented to undertake the work. In the year 1890 an Act was obtained for the extension of the railway from Stockwell to the Plough at Clapham. Since that date Parliament has twice extended the time limited by the Act, on the company representing that it was useless to bring a large accession of traffic on to the existing line, until provision had been made for dealing with it by the construction of the extension through the City. As the latter works are now in progress it is undesirable to ask Parliament for a further extension of time. The period for the compulsory acquisition of the land for stations expires in August next, and your directors therefore propose to take steps to acquire the land required for the two stations contemplated, and to have the plans prepared, and arrangements made for carrying out the works with a view to their completion soon after the City extension has been opened for traffic. With that view they ask the shareholders' sanction to issue when required the 5,000 5 per cent. preference shares, the balance of the preference capital already created on June 30th, 1891, and also to create the small amount of additional ordinary share and loan capital authorised by the Act of 1895. The directors retiring by rotation are Messrs. Sampson Hanbury and Spencer Barclay Heward, who, being eligible, offer themselves for re-election. Messrs. Turquand, Youngs, Bishop and Clarke are the auditors to retire on this occasion, and are eligible for re-election.

The Direct United States Cable Company, Limited.

THE report of the directors for the six months ended December 31st, 1896, to be presented at the thirty-ninth ordinary general meeting of the company, to be held at Winchester House (Hall No. 174), 50, Old Broad Street, in the City of London, on Tuesday, January 26th, 1897, at 2 o'clock p.m., states that the usual statements for account for the half-year ended December 31st, 1896, are submitted herewith. The half-year's revenue, after deducting outpayments, amounted to £47,601 2s. 1d., as compared with £43,938 9s. 4d. for the corresponding period of 1895, showing a difference of £3,662 12s. 9d. in favour of the half-year under review. The working and other expenses for the same period, including income-tax, but exclusive of cost of repairs of cables, amounted to £19,815 13s. 6d., leaving a balance of £27,785 8s. 7d. as the net profit, making, with £4,235 11s. 11d. brought forward from the previous half-year, a total of £32,021 0s. 6d. For the corresponding period of 1895, the working expenses and other payments amounted to £19,057 15s. 9d. Interim dividends of 2s. 6d. per share for the quarter ended September 30th, 1896 (paid October 24th, 1896), and of 2s. 6d. per share for the quarter ended December 31st, 1896 (payable January 30th, 1897), together amounting to £15,177 10s., have been declared, and after setting aside £12,000 to the reserve fund account, the balance of £4,843 10s. 6d. on the revenue account has been carried forward. The general improvement in business has made itself felt in Atlantic telegraphy, while the outlay for repairs during the past half-year has been small, viz., £529 2s. 2d., which has been debited to the reserve fund account as heretofore. After crediting this account with interest, realised profit, and the amount set aside from revenue account, and charging it with £3,000 written off the Ballinskelligs buildings account, the balance now amounts to £327,801 7s. 8d.

Commercial Cable Company—Baring Brothers & Co. are prepared to receive applications for £400,000 sterling 4 per cent. 500-year debenture stock issued, at 94 per cent., by the Commercial Cable Company, being part of an issue of $20,000,000, or the sterling equivalent, £4,120,000, represented by bonds or debenture stock ranking *pari passu*, and secured by a mortgage in favour of the Farmers' Loan and Trust Company of New York as trustee.

The St. James's and Pall Mall Electric Light Company, Limited.—The directors recommend a dividend for half-year ending December 31st of 8s. per share, on the ordinary shares, making with the interim dividend 10½ per cent. for the year 1896.

Stock Exchange Notice.—Application has been made to the Committee to allow the House-to-House Electric Light Supply Company, Limited—Ordinary shares to be quoted in the Official List.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending January 17th, 1897, were £1,085; week ending January 19th, 1896, £1,004; increase, £81; total receipts for half-year, 1897, £3,273; corresponding period, 1896, £3,041; increase, £232.

The Liverpool Overhead Railway Company. The receipts for the week ending January 17th, 1897, amounted to £1,278; corresponding week last year, £1,172; increase, £106.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 15th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,856.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Jan. 18th.	Closing Quotation, Jan. 20th.	Business done during week ended Jan. 20th, 1897. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	...	53 — 56	53 — 56	56	55½
2,993,560£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	...	98 — 99	97½ — 98½	99½	98⅜
2,993,560£	Do. do. Defd.	Stock	...	...	...	10⅜ — 11	10¼— 10⅜	10⅜	10 3/16
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	14⅜— 15¼	14⅜— 15¼	15¼	15
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	...	3¼— 3⅜	3¼— 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	12 — 13	12 — 13	12⅝	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	18½— 19½	18½— 19½	19	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	...	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	...	105 —108 %	105 —108%	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	...	9½ — 10	9½— 10	9⅞	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17 — 17½	17 — 17½xd	17½	17⅛
70,000	Do. 6 % Cum. Pref.	10	6 %	6	...	18 — 19	18 — 19 xd	18⅛	18¼
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	104 —107	104 —107	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	127 —130	127 —130	130	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	17 — 17½	17¼— 17⅜xd	17⅜	17½
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	...	100 —104	100 —104	102	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	128 —131	128 —131	129½	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	108 —111	108 —111	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	...	109 —112 %	109 —112 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	...	10½— 11	10⅝— 11¼	10 15/16	10½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	17 — 17⅓	17¼— 17⅜	17⅝	17½
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	10 %	...	24 — 25	24½— 25½	...	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	104 —107	104 —107	107	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	53 — 55	53 — 56	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	...	7½— 7⅝	7½— 7⅝	7¾	7 9/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	17 — 19	17 — 19	17½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	17 — 19	17 — 19	17⅜	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	...	6⅜— 7	6⅜— 7	6⅞	6⅜
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	...	105 —108	105 —108	107	105½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4½%	5 %	...	1 1/16— 1 1/8	1 1/16— 1 1/8	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	106 —109	106 —109	...	...
11,839	Reuter's Ltd.	8	*nil*	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	138 —143	138 —143	...	...
58,000	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3¼— 3⅜	3¼— 3⅜	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	100 —105	100 —105	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	4 %	...	5 — 6	5 — 6	...	...
238,380£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	103 —106	103 —106	...	...
39,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	0 — 1	0 — 1	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	89 — 95	92 — 98	92	...
54,248	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	...	8½— 8¾	8¼— 8⅜	8⅜	8¼
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6½— 6⅝	6½— 6⅝	6⅝	6 9/16
33,129	Do. do. do. Def. Ord.	7½	1 %	1 %	...	2½— 2⅝	2½— 2⅝	...	...
165,200£	Do. do. do. 5 % Debs. "A," 1880 Red.	100	6 %	6 %	...	105 —109	106 —110	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	...	105 —109	106 —110	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	...	1½— 1⅝	1½— 1⅝	1 5/16	1 3/16
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	11½— 12	11½— 12	11⅝	...
4,569	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9½— 10½	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	107 —110	107 —110	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	107 —112	107 —112	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	...	100 —105	100 —105	102	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	...	9½— 9⅝	9⅝— 10¼	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	...	8½— 9	8½— 9	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	4½%	...	112 —115	112 —115 xd	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	...	15½— 16½	15½— 16½	16½	16
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	16½— 17½	16½— 17½	17⅛	17
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	128 —132	128 —132	...	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	*nil*	...	8 — 9	8 — 9	8⅜	...
20,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	6 %	...	13½— 14	13½— 14	13⅜	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	9½ -- 10½	9½— 10½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	3 %	4 %	...	12½— 13½	13 — 14	13⅜	13 3/16
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	6½— 7	6⅝— 7¼	7	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	119 —122	119 —122	121⅜	119
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	...	10½— 11½	11 — 12	11¼	11
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	12 — 13	13 — 14	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9½ — 10½	9½ — 10½	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	5 %	7 %	...	11 — 12	11 — 12	11⅜	11½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless therwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Jan. 13th.	Closing Quotation Jan. 20th.	Business done during week ended Jan. 20th, 1897. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	2½%	...	...	⅝ — ¾	¾ — 1	1 1/16	⅝
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1 — 1⅛	1⅛ — 1⅜	1⅛	1 1/16
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	...	...	110 —113	109 —112	110	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	94 — 98	94 — 98	95	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	...	...
207,649	Do. do. do. £4 paid	10	...	...	...	3¼ — 4	3¼ — 4	3 7/8	...
630,000£	City and South London Railway	Stock	1½%	1 3/16%	1 9/16%	56 — 58	58 — 60	60	56½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1⅜ — 2¼	1⅜ — 2¼	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	1⅜ — 2¼	1⅜ — 2¼	1⅞	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	4½%	4½%	...	105 —110	105 —110	105	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	...	1⅜ — 1⅝	1⅜ — 1⅝	1⅝	1 9/16
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2½ — 3	2½ — 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	⅜ — ⅝	⅜ — ⅝	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	¼ — ½	¼ — ½	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	10½ — 11½	10½ — 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	...	17½ — 18⅝	17½ — 18⅝	18¼	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	...	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	...	109 —114	109 —114	113½	112
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	...	20½ — 21½	20½ — 21½	21⅜	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	106 —109	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	2½%	...	14½ — 14⅝	14 — 14½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	...	16½ — 17	16½ — 17	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	...	40 — 43	40 — 43	40½	40¼
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	...	102 —105	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	7½ — 8	7½ — 8	7⅞	7¾

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—3%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9⅛.
Electric Construction Corporation, 6 % Debentures, 102—105 xd.
House-to-House Company (£5 paid), 4¾—5¼.
Do. do. 7 % Preference, of £5, 9—9½.
Do. do. 4½% Debentures of £100 107—109 xd.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 8½—8⅝.
London Electric Supply Corporation, £5 Ordinary, 1—1¼.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6¾—7¼

* From Birmingham Share List.

Bank rate of discount, 4 per cent. (October 22nd, 1896).

A DOMESTIC ELECTRIC LIGHTING INSTALLATION.

ONE of our subscribers sends us the following communication :—There are still many people that are afraid to give their consent to the installation of electric lighting apparatus. Some urge that the cost is excessive, and others that too much space is required. Others, again—and, in my opinion, these constitute the largest class—are not deterred by the cost, but think that they will be obliged to employ a special person to look after the engine. In the hope of overcoming these prejudices, I propose to describe the installation which works in my house to my entire satisfaction.

It is said that considerable space is required! A mistake: my engine, its dynamo, the switchboard, and the 30 accumulators, are placed in a little room 2½ metres by 2 metres. You see that this is not a large space.

I will now discuss the mechanical and electrical question. The lighting of my house is effected by about 25 lamps of luminous powers varying from 5 to 16 candles. As a rule, only five to six lamps are burning, but the accumulators can feed from 15 to 18 for about seven hours.

The motive force is produced by a little gas engine of about ¾-H.P., of a type that is very simple, and works excellently; this is mounted on a little brick base about 60 centimetres in height. It drives by means of a belt a little Gramme dynamo of 10 amperes at 55 volts, with fly-wheel. For regulating the tension of the belt, I have mounted the dynamo on a slide, which is very simple, but fulfils its purpose satisfactorily; it consists of two wooden bars grooved along their length. In these grooves are placed the heads of bolts, and I have screwed on two flat bars of iron, which are separated from one another by exactly the width of the screw thread. If I wish to do the lighting directly without the aid of accumulators, I simply make the current pass through the amperemeter and the circuit breaker, and I take a derivation for the voltmeter working between 55 and 58 volts.

If, on the other hand, I use the accumulators, I give my dynamo 75 to 80 volts, and 6 amperes for the charge.

The accumulators are of a capacity of 85 available ampere-hours, which is quite sufficient for a private house. The line that conveys the current from the place where the engine is to the house consists of four wires; two wires of 30/10 supported by double-bell insulators and two wires for an alarm, of which I shall speak presently. On reaching the house the two wires are carried to a little board comprising a general circuit breaker, a bell, and the plate from which proceed the chief circuits of the house, each having its circuit breaker above the plate. The lamps employed are of the 50-volt type, but they are over-run to 58 volts, as I do not employ a reducer, and prefer a good light, and to renew my lamps oftener, rather than complicate the working. This system enables me to use 10-candle instead of 16-candle lamps. The working does not necessitate the employment of a special workman.

Theoretically, the accumulators should furnish the light for five evenings without being charged, but practically I prefer to discharge them for three evenings only, for, instead of using my engine for 18 or 20 hours, as in the first cases, 10 hours are sufficient, the consumption during the long evenings being altogether 15 to 18 ampere-hours per day. However, if there were any occasion, I can obtain an output of 10 ampere-hours for six to seven days in succession. On charging days, I start the engine early in the morning, I adjust the disconnector, regulate the lubricators and the voltage, and I need not trouble any further about it for three or four hours. As, however, from some cause or other, the voltage might fall or the engine stop, an alarm is arranged to give notice of such an occurrence; this avoids constant surveillance. Under the disconnector is placed a little index of copper connected to one of the poles of a bell, and the axle bearing the rod of the disconnector is connected with the battery. When the disconnector falls, the bell rings, and I am warned. In my absence, all that need be done is to turn off the gas at the meter; thus there is no

danger of accidents, and if this is done, as the accumulators remain on circuit, the lighting can still be effected.

Now comes the question of cost, which is also an important one; the cost of this little installation all complete, including the tubing, with the exception of the little shed, was about 2,200 francs. This is little considering the services it is capable of rendering. In a little while, I hope to add heating on a small scale by means of an electrical heater for keeping dishes hot for the table.—AN AMATEUR ELECTRICIAN OF VALENCIENNES (*Revue Pratique de l'Electricité*).

ELECTRICAL WAVES IN LONG PARALLEL WIRES.*

BY A. D. COLE.

(*Concluded from page* 67.)

The result is of the sort that we would expect, as the proximity of the metal box would naturally increase the capacity of a given length of the wires in that neighbourhood, rendering a shorter length necessary.

Later experiments, in which there were two internodal spaces before the box was reached, developed the fact that the influence of the box upon the half wave external, but adjacent to it, was considerable, since this half wave was invariably 5 cm. shorter than the one more remote from the box.

When the box was filled with distilled water only, a small constant deflection of the galvanometer was obtained, and this was shown to be due partly to a direct magnetic effect of the induction coil upon the galvanometer, and partly to current induced in the bolometer wires from the wires connecting the induction coil and storage battery.

Up to this time the little Leyden jars had always been placed at the remote end of the parallel wires. The jars were now removed, and still smaller ones of the same sort placed at the ventral segments of the two external half waves. Although these had very small outer coatings, consisting of copper foil 5 mm. in diameter, and 5 mm. long, it was found that their capacity could not be neglected, but was equal to 2·5 cm. wire length. Still smaller jars were next made of a single turn of very fine wire about a glass tube 5 mm. in diameter. This was found to make no appreciable change in the position of the maxima, and still, when placed at a ventral segment and connected to the dynamo-bolometer, large deflections (100 mm.) were obtained.

Very fine resonance systems were obtained in the external portion of the parallel wires in those experiments where a node was forced at the box end, and better than had been obtained with the parallel wires alone. This result is not attributed to the presence of the box, but rather to the use of the Leyden jars at intermediate ventral segments, and to the readjustment of bridges already placed when the capacity of the system was changed by adding a new bridge.

Thus in one experiment with bridge fixed at box end, 255 nodes were located as follows :—

Notice nodes at 14·5, 135 and 255 show intervals 120 and 120·5; mean $120·3 \times 2\frac{1}{2} = 501$.
Notice nodes at −2, 85, 169, 255, show intervals 86, 84, 87; mean $85·7 \times 3\frac{1}{2} = 500$.
Notice nodes at 57, 124, show intervals 67; $\times 4\frac{1}{2} = 501·5$.

i.e., according as the nodal position occupied belonged to group 1, 2 or 3, the vibrating system consisted of $2\frac{1}{2}$, $3\frac{1}{2}$ or $4\frac{1}{2}$, half waves.

These results gave a simple means of calculating the equivalent of the secondary plates and the wires connecting to the parallel wires in terms of the equivalent length of parallel wires. As the parallel wires began at −7 of the scale, the first node (−2) is 5 cm. from one end of the parallel wires, but the whole part of the system beyond this node $= \frac{86}{2}$ or 43 minus 5 = 38 as the equivalent in cm. of the parallel wires for the capacity of the end plate 6 × 6 cm. and the 11 cm. of wire leading from it to the parallel wires.

From another system of nodes we get in the same way the same result. Thus:

$\frac{120}{2} = 60$ minus $(7 + 14·5) = 38·5$ or practically the same as before.

From another experiment with a system of very different length of parallel wires, the wire equivalent of the same plates come out 39·2 and 40; mean, 39·6.

The distribution of energy in the internodal spaces was next investigated. Bridges were placed at two nodal positions external to the box, and the Leyden jars moved from one end of the intervening half wave to the other at intervals of 10 cm. In each position four readings of the galvanometer were made, the mean values taken as ordinates for a curve whose abscissas were bridge positions, gave directly the distribution of electrical energy in the wires. For positions between successive nodes a very smooth and regular curve was obtained, which differs but little from a sine curve.

When a bridge was placed at the box end, to force a node there, filling the box with distilled water left the wave system in the air-surrounded portion of the wires unchanged, but only slight and unsatisfactory traces of a wave system could be detected within or beyond the box, whether by Leyden jars placed at the end, or by those placed on the wires within the liquid. Of course the introduction of the liquid, by the change in capacity, might be expected to destroy the resonance within and beyond the box, but it was hoped that by careful adjustment of a variable capacity at the ends, the

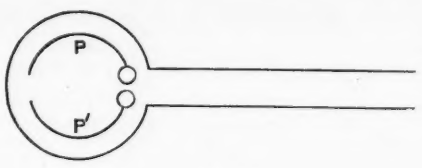


FIG. 3.

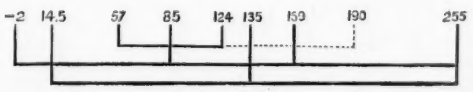


FIG. 4.

total capacity of this part of the system might be increased exactly to some simple multiple of its former value, and resonance restored. These hopes proved delusive. The capacity at the end was gradually varied by different means through wide limits; but any such change seemed to make no difference whatever in the resonance conditions within. This attempt was then given up, and special attention paid to attaining (*a*) great galvanometer sensitiveness, (*b*) great purity in the semi-conducting liquids used, (*c*) using vessels that the liquid would have no action upon glass and silvered glass, and (*d*) taking very short intervals along the wire between successive series of readings. Kohn had used this method already to determine the refractive index of water. By the use of all these precautions well defined maxima were finally obtained, both with water and alcohol. The maxima, however, were less sharp, and far weaker in the portion of the wire surrounded by liquid than in that surrounded by air. As, however, the half wave-length is considerably less in the liquid (only one-ninth as much in water as in air), it was possible to obtain as many as four maxima, even within a vessel 78 cm. long. The details of this portion of the work are described in the recent paper in *Wiedemann's Annalin*, to which reference has already been made.

Recently I have been making experiments with the Blondlot exciter of electrical oscillations, which, according to a recent paper by Drude, is better suited for developing oscillations in long parallel wires than the Lecher form which I used before. In this there are no pairs of primary and secondary plates, but the inner ends of the parallel wires are joined by a circularly curved wire, shown in fig. 3. Within, and separated from this circular wire by only a small distance, is a pair of primary exciters, P, P', bent so as to form arcs of a circle concentric with the surrounding wire, and carrying brass balls for a spark gap at the inner ends. These exciters

* Abstract of paper read before A. A. A. S., Buffalo meeting, taken from the *Electrical World* of New York.

are connected to the secondary terminals of an induction coil.

I have also followed Drude in using a strip of mirror with its metallic film cut across with a sharp knife or diamond point, as described by Righi, as a substitute for the Geissler tube of Lecher, or the dynamo-bolometer of Rubens, but as yet have not by their means made any important additions to the results obtained with the earlier apparatus.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

PRESIDENTIAL ADDRESS BY SIR HENRY MANCE.

Delivered January 14th, 1897.

[Abstract.]

(*Concluded from page 73.*)

In order to effect the repairs which are necessary, a fleet of 41 telegraph ships is maintained: the gross tonnage of the telegraph marine being nearly 60,000 tons. The vessels are stationed in all parts of the world, and are fully equipped with the usual machinery for grappling, picking up, and re-laying. This machinery is substantially very similar in design to what it was 30 years ago.

The type of cable now generally adopted for deep water is a great improvement on that used in the earlier deep-sea cables. Five-and-twenty years ago the best wire used for cables had a breaking strain of, say, 50 tons per square inch. To-day wire is easily obtainable having a breaking strain of 90 tons per square inch. The application of a preservative tape and compound to each of the wires forming the sheathing, a plan, I believe, originally adopted at the Silvertown works, must tend to prevent or retard corrosion. As compared with a cable in which the iron guards rest one against the other, there is a saving in weight, in cost of materials, and although the breaking strain may be slightly reduced, the cable will bear as great a length of itself in water as an apparently stronger type. The deep-sea portion of the latest Anglo-American cable and of the South American cable are made of this type; and I consider the design an important improvement upon the old plan, where, to lessen the specific gravity, the sheathing wires were separated by intermediate yarns.

The cost of repairs is a most serious item in the accounts of a telegraph company, but there is a great element of luck in cable maintenance, and fortunately, with deep-sea cables there is comparative freedom from interruption, though when breaks do occur in great depths the cost of re-establishing communication is likely to be very considerable. Repairing one of the Anglo-American cables is said to have cost on one occasion £95,000. This is probably the most expensive repair on record.

The following brief notes regarding the amount of spare cable which may be necessary to effect repairs during the life of a cable laid in comparatively shallow water may be useful. You will, of course, understand that such a return can only be approximate, as much depends upon the type of cable, and the care with which it was laid. My experience shows that during the first five years of the life of a shallow water cable, it is prudent to allow for ½ per cent. per annum of its total length to provide for repairs.

From the	6th to 10th year, say	¾	per cent.
„	11th to 16th year	„ 1	„
„	17th year	„ 1¼	„
„	18th „	„ 1½	„
„	19th „	„ 2¼	„
„	20th „	„ 2½	„
„	21st „	„ 3	„

In addition to this expenditure of fresh cable, we have also to consider the cost of the engineering staff, and the maintenance of the repairing steamer, should an independent vessel be employed. Three per cent. on the total length of the cable per annum, after 21 years, does not at first sight appear to be considerable for a shallow water cable; but there comes a time when, in consequence of the great public inconvenience, loss of revenue, and cost of repairs, it is cheaper either to make extensive renewals, or to lay a new cable. Assuming the cable to be 1,000 miles in length, and that the before-going estimate is approximately correct, then 30 miles of cable would be expended annually. This would probably mean 10 or 12 interruptions. As a matter of fact, 16 interruptions was the actual number that occurred in the Persian Gulf cable of 1,740 knots during the 21st year. The inconvenience of such frequent repairs was felt to be so great, that the alternative of picking up, stripping, and re-sheathing nearly the whole of the section at the Government cable factory at Karachi was resorted to with most advantageous results.

Many years ago (in the seventies) I had the privilege of being allowed to inspect the working on the Atlantic cables at Valentia. For several days I watched the signalling conducted by operators, who were splendid "mirror" readers. The siphon recorder had not then come into general use. A rate over 20 words, or 100 letters, was obtainable during a trial; but I noticed the speed obtained in practice, when messages containing a fair proportion of foreign and code words were being transmitted, was 15 and 16 five-letter words per minute. At this rate, 50 or 60 10-word tariffs were transmitted within the hour. This included preambles, collations, and repetitions, the latter being extremely rare. By abbreviating the preamble and collations in accordance with modern practice, greater commercial efficiency is obtained, and the proportion of words paid for becomes greater. As an instance of how the commercial efficiency can be worked up under pressure, I may mention that during an occasion when the whole of the traffic to and from the East was thrown on the Persian Gulf line, the number of telegrams passed through the cable during the 24 hours was rapidly increased from about 650 to nearly 1,000 daily.

Great Britain supplies the majority and the best of our telegraphists for long submarine cables; in reading the mirror, recorder and manipulative skill, they far surpass the operators of any other nation. In working landline Morse circuits by "Sounder," the Americans are the only people who can compare in rapidity with our countrymen. It is to be regretted we do not see more of our telegraph friends at the meetings of this Institution. Telegraph administrations should, I think, encourage their employés, especially those that are to serve at foreign stations, to take every opportunity to render themselves thoroughly proficient not only in a knowledge of the apparatus in daily use, but also in a knowledge of testing. A clerk is none the worse operator because he happens to be an intelligent electrician. The life at isolated cable stations must often be a dull one; and if the employé can be encouraged to devote his spare time to improving his mind by the study of a most fascinating and interesting subject, the result, I am convinced, would be beneficial in many ways, not only to the man, but the company he serves.

In connection with testing, I may be permitted to give a word of advice to young beginners: use few formulæ, the fewer the better, but apply them with judgment. Test as soon as you can after the occurrence of a fault, see that your plugs and contacts are clean, and if you are in a cable ship, keep your head cool. The average distance between the assumed and actual position of faults in the Persian Gulf cable, where the sections vary from 150 to 500 miles in length, is, I find from a recent report for that department, less than one-third of a knot, so that the electrician can localise the breaks closer than the captain can navigate his vessel.

Thirty words per minute is a high speed for a writer, and no average signaller could maintain a greater speed with the mirror key for any length of time. The results obtained from the cables last laid by the Commercial and Anglo-American Telegraph Companies show that it is possible to transmit nearly 50 words of five letters each per minute; this, of course, has to be effected by means of an automatic transmitter. The introduction and universal adoption of this adjunct will, no doubt, considerably increase the carrying capacity of our cable. An ordinary automatic transmitter may not appreciably increase the speed of working on very long cables; but by the use of the automatic curb transmitter with an adjustable curb commutator, the speed of working has, I understand, been increased on some of the Eastern Telegraph Company's cables at least 30 or 35 per cent.

The invention of the telegraph and its subsequent development is closely associated with the reign of Her Most Gracious Majesty. But the work of the telegraph engineer is in one respect incomplete. It still remains for him to establish a girdle round the earth. The question of a Pacific cable has again come to the front. A committee has been sitting at the Colonial Office for the purpose of considering the matter. The points which suggest themselves for consideration are: Is the Pacific cable desirable for strategic reasons? Is the scheme feasible? To these questions any statesman or telegraph engineer would, I think, unhesitatingly answer in the affirmative. It would be difficult to over-estimate the strategic value of the Pacific line. At the same time I do not attach too much importance to the much-talked-of telegraphic isolation of England which is feared immediately we are involved in warfare with any great European power. This is held up to us as a sort of "bogey." If our fleet does its duty, and it generally does do its duty, any cable-cutting craft which may adventure into the shallow waters near our shores, or near those of our Colonies, may be expected to meet with an unpleasant reception. On the other hand, the wholesale destruction of cables in deep water will not prove an easy task to the comparative amateur. It takes a certain amount of time to grapple a cable in deep water, even when the exact position is known. The popular imagination pictures the work of destruction as being carried out by 20-knot cruisers in something like the twinkling of an eye. Cable catching is not to be learned in a day. I do not think the malicious damage to cables in deep water need be greatly feared, and it may be taken for granted that our cable ships would quickly repair the damage inflicted in shallow water, unless the enemy held command of the sea. Nevertheless, the more telegraphic routes we have to our Colonies the less the probability of their being isolated in the event of war, and the less the chance of panic in time of peace. Nothing more disheartening for the would-be destroyer of cables can be imagined than the knowledge that there are so many routes available for sending messages, so that the destruction of any one cable would hardly be worth the risk. When our network of telegraphs is complete, with cable ships judiciously placed for repairing purposes, and fast cruisers to watch the more exposed portions of the route, there ought to be little risk of Great Britain being completely isolated from her Colonies in time of war.

Telephone and Fast-Speed Cables.

We may reasonably hope that we are on the eve of substantial developments in connection with the methods of submarine electrical communications. I am not now speaking so much of improvements such as the duplex or the high-speed automatic curb transmitter, but of fundamental alterations in the structure of cables which we may anticipate will result from the consideration the subject is receiving from our highest authorities. I do not suppose that we shall see an ideal cable manufactured straight off the reel, or that cable companies will be too ready to incur the risk of acting on the suggestions of inventors. Of course, mistakes will be made, but I look with confidence to the day when these efforts shall bear fruit. A day may

come when our electricians will design, and our engineers construct, a cable which will enable us to hold converse by telephone with our trans-Atlantic brethren.

In Mr. Preece's proposed cable, designed for telephone work, and described in a paper read before the British Association, there are two conductors, semi-circular in section, in each core, thus providing a complete metallic circuit. The conductors are first separately insulated with brown paper, then arranged with the flat sides pressing closely against each other, with only the brown paper between them. The twin conductor thus formed is insulated with gutta-percha in the usual way; it is claimed that as the conductors are made to approach each other, the electro-magnetic induction increases at a greater rate than that of the electrostatic induction, until at a certain point the one will neutralise the other.

Prof. Silvanus Thompson aims at increasing the speed of working on long ocean cables by using a double core, forming a complete metallic circuit, and establishing at intervals permanent inductive leaks or bridges of very high resistance between the two wires. These intermediaries are well insulated, and may be 50 or 100 miles in length; they would be laid in with the double core and connected at their extremities, so as to form a bye-pass between the two conductors. In an Atlantic cable three or four of these derived circuits would probably be required. The advantage of introducing leaks at intervals, where practicable, on a long cable, is well understood; I have used them with advantage myself where we had intermediate stations available, so that ordinary resistance coils could be used to connect the cable with earth.

Prof. Thompson anticipates that with a cable of this type, with several leaks, he would be able to transmit signals across the Atlantic at six or eight times the speed at present obtainable. It must, however, be remembered that in increasing the number of cores, we should considerably increase the cost of the cable; as a matter of fact we should be putting, say, two eggs into one basket. The cost and telegraphic capacity would, therefore, have to be compared with that of two good modern single core Atlantic cables.

A third system has been suggested to me by Messrs. Phillips and Barr.

They propose to employ what is practically a double conductor, but the return circuit for each wire, or group of wires, would be the earth. It is intended that the insulation between the two conductors, or groups of conductors, should be comparatively low, so that an appreciable amount of leakage would occur from one circuit to the other. By means of a suitable key, one conductor would be simultaneously charged with a similar current, as the other is discharged, and it is claimed that the fall of energy on the one circuit, as it is disconnected from the battery and put to earth, would be balanced by the rise of potential on the other, so that the retarding effects of static induction would be reduced to a minimum.

In quitting the subject of submarine telegraphy for this evening, I would remark that it has not been my intention to give you a paper embracing the history up to date of this important branch of electrical science. I have, on the contrary, endeavoured to keep off the beaten track, my aim, I confess, being to interest rather than to instruct.

In lighting, traction, and transmission of power over short distances, electricity has to encounter formidable rivals; perhaps it is as well that it should be so, as wherever two branches of science, still in the stage of vigorous growth, meet, there may we look for striking developments, and all the more so when the two sciences in question have met with important industrial applications. The use of electricity in connection with the various processes pertaining to electro-chemistry has made satisfactory progress during the past year. The results already obtained, and the wide field that presents itself for further operations, suggests that chemistry will in future be one of the most important studies for the student who wishes to advance to the front rank of the electrical profession. The ease and accuracy with which electrical action can be regulated under its extensive utilisation in chemical and metallurgical processes suggest great possibilities in the immediate future. The processes for the most part are electrolytic, but most important work is being done by utilising the intense heat of the electric arc. The production of alkali and chlorine by the decomposition of salt naturally first engages our attention.

Large works are being erected near Widnes for the purpose of carrying out the Castner-Kellner process for the production of caustic soda and chlorine. The Holland process for a similar object is being developed by the Electro-Chemical Company at St. Helen's, where, I understand, 4,000 H.P. will shortly be at work.

One of the most successful processes in which electricity is employed is the production of aluminium; this is in operation on a large scale at Pittsburgh, the Falls of Niagara, and also at Foyers, in Scotland.

Large works are in operation in Sweden, Switzerland, and France, for the production of chlorate of potash, and further installations are contemplated for the United States.

The decomposition of gold from cyanide solutions is being successfully carried out on an increasing scale in South Africa by the Siemens-Halske process; and this firm has also developed a process for the deposition of zinc from zinc ores, which is likely to come into extensive use. The researches of Monsieur Moissan has given a great stimulus to the methods which rely on the use of an electric furnace. The processes involve for the most part the formation of new combinations, such, for example, as carborundum, a carbide of silicon, which can be used in place of emery powder. 1,000 H.P. is employed in producing this material at Niagara. Other carbides have been produced on a large scale, more especially carbide of calcium, which by the action of water yields acetylene gas. Phosphorus is also now manufactured on a commercial scale by means of the electric furnace.

Serious attention has been given by chemists to the fascinating problem of obtaining electrical energy direct from carbon. To Prof. Oswald must be given the credit of having, at a meeting of German Electrical Engineers, in Leipzig, during 1894, stimulated the activity of the genuine electro-chemist. As a result we have had the Borcher's cell, in which it was thought at first that the electrical energy obtained was derived from the combination of carbon monoxide and oxygen, cuprous chloride acting as the intermediary. Then came the Coehn cell, with an apparently soluble anode of carbon, a cathode of lead peroxide and sulphuric acid as the electrolyte. A primary battery claiming to produce electrical energy direct from carbon, must, like Cæsar's wife, be above suspicion. Although the elements of practical success are wanting in the instances I have mentioned, it is pleasant to bear testimony to the *bonâ fide* attempts made to solve this great problem, and it is a matter of congratulation that the investigations are being conducted by men of scientific repute.

In my address this evening I have chiefly dealt with facts which are beyond question. In my concluding remarks, which I promise you shall be brief, I may touch on topics regarding which there is a divergence of opinion. You will understand, therefore, that I am speaking on my own responsibility. We are all agreed it is imperatively necessary that as an Institution we should keep in the front rank; but, to ensure this result, we must stand shoulder to shoulder, and do what we can to retain the sympathy of all sections of our members, and keep in touch with every branch of our profession. If it is inevitable that from time to time there should spring into existence offshoots from the parent society, or associations with similar objects, they should, if possible, be brought to act as buttresses, and not partake of the nature of rifts in the foundations of the Institution. I feel sure your Council would be glad to see their way to gratify, as far as possible, the natural aspirations of any section of the Society, and meet the reasonable requirements of all. Possibly, as the basis of the Institution broadens (and I do not see any finality to our sphere of usefulness), the solution of the question will eventually be the formation of local committees, and the simultaneous reading of papers, the various discussions on which could afterwards be printed in the *Journal* of the Institution.

In making a forecast as to our future, I may be permitted to refer to one item in the accounts recently presented at our general meeting, namely, the amount standing to the credit of the building fund. Whatever divergence of opinion may exist as to the advisability of taking early action in the matter, there can, I think, be no question that the provision of a building for the purposes of the Institution is a matter of paramount importance. It is our duty to seriously consider whether the interests of the Society are not prejudicially affected by our inability to offer to our members, or any subsidiary associations which may be affiliated with us, the convenience of a central place of meeting and research. We have at present a name, but not a habitation of our own.

No one appreciates more than myself the generous treatment we have received from the Institution of Civil Engineers, or the advantages of this magnificent place of meeting; but the time may come, and it assuredly will come, when our frequent occupancy of this hall may not be convenient; and it behoves us as business men, remembering that Rome was not built in a day, to endeavour to make timely provision for such a contingency. We must not shut our eyes to the fact that, notwithstanding our growing importance, we have fewer meetings now than we had eight years age. If this Institution is to continue to lead the way in electrical science, it must be fed by contributions in the way of papers from its members; and to do justice to these contributions, it is equally obvious that we must have more meetings at which to discuss them.

Let us look for a moment at the immediate future. First, there is the Pacific cable, the dream of telegraph engineers, who desire to share in the honour of completing the girdle round the earth. Next there is the establishment of telephonic communication through long submarine lines, and its corollary fundamental alterations in the form of our future cable. Turning to another branch of the electrical industry, we have two important underground electrical railways in course of construction in the metropolis, and several others, the Bills for which will be presented to Parliament during the coming session. London will be pre-eminent throughout the world in regard to electric railways, as she is in every other respect. The new applications of electricity in connection with electro-chemistry and electro-metallurgy are most important. Who can prophesy as to the next position from which electric science and enterprise will exercise its beneficent influence? The chemist, the electrician, the engineer, ever seeking, ever striving, to discover new natural agents, and to apply them to practical use. To me it seems the outlook is full of promise. The prospect of continued activity in connection with electric lighting, electric traction, and mining machinery, is most satisfactory. Electric light mains, lamps, and storage batteries, will assuredly receive continued attention. The telephone business is steadily increasing, and the service improving by the adoption of the complete metallic circuit. The developments of the last 15 years are only an earnest of what is to come. Under these circumstances, I think we may enter our second quarter of a century with feelings of hope and confidence; and there is some justification in congratulating the junior members of this Institution upon their choice of a profession which is not only growing and progressive, but full of interest.

The boy is father to the man, the student of to-day is the raw (sometimes very raw) material from which we are manufacturing the electrical engineer of the future. It is to them the fortunes of this Institution will be entrusted; it is not in our power to give the clear head, cool judgment, steady nerve, and the faculty of acting promptly in cases of emergency, which is so invaluable to those who are placed in responsible positions; but it is quite within our province, indeed it is our duty, to make any suggestion which may be of service to those who intend to adopt electrical engineering as a profession.

I do not know whether my experience is similar to that of others;

but I have frequently found it as difficult to find the right man for the appointment as to find vacancies for the applicants.

Students now command far greater facilities for acquiring a knowledge of their profession than were available 20 years ago, but they should remember that much more is expected from them. The standard of excellence is rising, the training must be both theoretical and practical; and it is not until some practical experience has been acquired that the young engineer becomes of real value to his employers.

In conclusion, I would remind you that your duty towards the Institution does not altogether cease with the payment of the yearly subscription. Surely few of us have gone through life without learning something in connection with our profession, the knowledge of which would be useful to our members, and which might be imparted either in the form of a paper or communicated during the discussions which follow the papers of others. Throw diffidence overboard; the proper place for silent members is over the way—in the House of Commons. Try, if you can, to contribute one little pearl of truth to the common stock of knowledge; for, if, by the proper use of the talents entrusted to you, you are able to leave the world a little better—a little wiser—than you found it, believe me, gentlemen, you will not have lived in vain.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. THOMPSON & Co., *Electrical Patent Agents*, 322, *High Holborn*, *London*, *W.C.*, *to whom all inquiries should be addressed.*]

171. "Improvements in electric light and power fittings especially adapted to boxes used in connection with armoured conduit systems of wiring." F. BATHURST. Dated January 4th.

203. "Improvements connected with accumulators or secondary batteries in electrically-propelled vehicles." C. RODERBOURG. Dated January 4th.

246. "Improvements in means for adjusting electric light carbons." A. H. GIBBINS. Dated January 5th.

248. "Improvements in or relating to apparatus for supplying a certain definite amount of electric current for lighting or other purposes." W. D. WATSON. Dated January 5th.

251. "Improvements in secondary batteries and process of forming same." G. W. HARRIS and R. J. HOLLAND. Dated January 5th. (*Complete.*)

265. Electrical indicating railroad signalling." G. GRIFFITH. Dated January 5th.

272. "Improvements in secondary battery supports or girds." J. J. ROONEY. Dated January 5th. (*Complete.*)

293. "An improvement in commutator connections for dynamo-electric machines and motors." SIEMENS BROS. & Co., LIMITED, and A. GROTEFIELD. Dated January 5th. (*Complete.*)

332. "Improvements in carriers for incandescent electric lamps." H. M. SALMONY. Dated January 5th.

335. "Improvements in fitting electric incandescing lamps with 'leading in' wires." J. A. SINCLAIR. Dated January 5th.

336. "Improvements in incandescent lampholders for electric light." L. B. STEVENS. Dated January 5th.

352. "Improvements in connection with paying out electric cable." C. S. SNELL. Dated January 6th.

363. "Improvements in incandescent electric lamp plugs." S. C. CABHEL. Dated January 6th.

384. "Improvements in electric governing devices for alternating currents." F. M. LEWIS. Dated January 6th.

393. "Improved means for generating and storing electric energy in railway carriages and similar vehicles for lighting and other purposes." C. D. JENKINS. Dated January 6th.

398. "Electric traction system with stationary and portable accumulator batteries." J. SCHUIL. Dated January 6th.

423. "Improvements in primary and secondary voltaic batteries." D. G. FITZGERALD. Dated January 6th.

425. "Improvements in or connected with secondary batteries." F. KING. Dated January 6th.

426. "Improvements in dynamo-electrical machines." V. A. FYNN. Dated January 6th.

439. "Improvements in incandescent electric lamps." C. O. WEBER and I. FRANKENBURG. Dated January 7th.

454. "Improvements in or relating to electric arc lamps for photographic or other purposes regulated by hand." G. DOWIE. Dated January 7th.

479. "A method whereby in an electric arc lamp the carbons may be maintained at a suitable distance for efficient lighting purposes." P. H. HOWARD. Dated January 7th.

483. "Improvements in electric arc lamps." A. G. STOCKWELL. Dated January 7th.

488. "Improvements in dynamo-electric machines and electro-motors." A. W. MARSHALL. Dated January 7th.

490. "Improvements relating to the electric deposition of metal on pipes, tubes, and other articles." W. WRIGHT. Dated January 7th.

498. "Improvements in apparatus for the electrolytic treatment of alkaline salts." A. KOCH. Dated January 7th.

509. "Improvements relating to dynamo-electric machines." H. H. GRENFELL. Dated January 7th.

550. "Improvements in and relating to conduits for electrical conductors and joints therefor." F. BATHURST. Dated January 8th.

614. "Automatic electric fire alarm and temperature indicator." R. BEACH. Dated January 9th.

615. "Improvements in and applicable to means for electrically obtaining ozone and employing the same for curative and other purposes." E. BOHM. Dated January 9th.

627. "Rectifying alternating currents." D. COOK. Dated January 9th.

631. "Improvements in primary batteries." W. P. FREEMAN. Dated January 9th. (*Complete.*)

652. "Improvements in or connected with primary electric batteries." D. W. B. E. THOMSON and H. C. BULL. Dated January 9th.

666. "Improvements in couplings for incandescent electric lamps." H. A. MAVOR, W. A. COULSON, and S. MAVOR. Dated January 9th. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., *price, post free*, 8½*d.* (*in stamps*).]

1896.

1,344. "Improvements in means for securing electric insulators, hooks, rollers, and the like to walls, girders, poles, and the like." A. BEAUJEAN. Dated January 20th, 1896. Relates to a means of securing electric insulators to poles, walls, &c., by means of a lath, the sides of which are obliquely turned up to form a wedge-shaped groove with slide block edges to correspond. The side blocks bearing the knobs are fastened in the groove by means of a screw which penetrates the block and knob, and pressing its lower end on the bottom of the groove, holds the knob in position. The adjustable hook to secure both to pole has its two parts united by a screw. 4 claims.

4,788. "An improved electric battery, and method or process of converting the potential energy of carbon, or carbonaceous materials, into electrical energy." W. W. JACQUES. Dated March 3rd, 1896. Relates to a method of causing oxygen, either pure or diluted, as in air, to combine with carbon or carbonaceous materials, not directly, as in case of combustion, but through an intervening electrolyte. In this way, the potential energy of the carbon may be converted directly into electrical energy, instead of into heat. One method described consists in immersing a cylinder of carbon in molten sodium hydrate, and forcing a current or blast of air into the molten salt in such a manner tuat it becomes impregnated with oxygen in excess. The circuit is completed from the sodium hydrate, which is the electrolyte, by means of a collecting electrode, not chemically acted upon by the electrolyte and an extraneous conductor to the carbon. 10 claims.

5,295. "Improvements in arc lamps." J. A. SEAVERNS. Dated 9th March, 1896. Relates to an improved method of regulating arc lamps, especially those designed for projection, and where a positive feed is of the most essential importance in order to maintain a steady light. The two carbons are fed forward by a clock mechanism, and a coil through which the supply current to the lamp is caused to pass serves to change the regular predetermined rate of the mechanism The clock mechanism is divided into two parts, which have no positive connection, but are united by some friction device. The balance-wheel is weighted, thus rendering the feed mechanism always in readiness to operate. 10 claims.

5,298. "Improvements in electric flash-light apparatus for photographic purposes." A. J. BOULT. (W. Bruns, U.S.A.) Dated March 9th, 1896. An improved method of electrically igniting the powder of a photographic flash-lamp simultaneously with the exposure. Means also provided to ignite the powder on two or more of the apparatuses at the same time. 20 claims.

6,208. "Improvements in automatic switches." A. BALLANCE and E. H. HEWSON. Dated March 20th, 1896. The invention has reference to Patent 6,391 of 1895, and relates to the automatic control of masthead and side lights of ships, also applicable as a burglar alarm. It consists of two differential wound solenoids, with cores connected to a central boss, provided with runners running upon a metal arc, a pivoted switch bar and contacts. The lamp has two filaments connected to a holder. The solenoid cores are provided with anti-friction runners, and the whole is actuated by a local battery circuit in combination with a main circuit. 2 claims.

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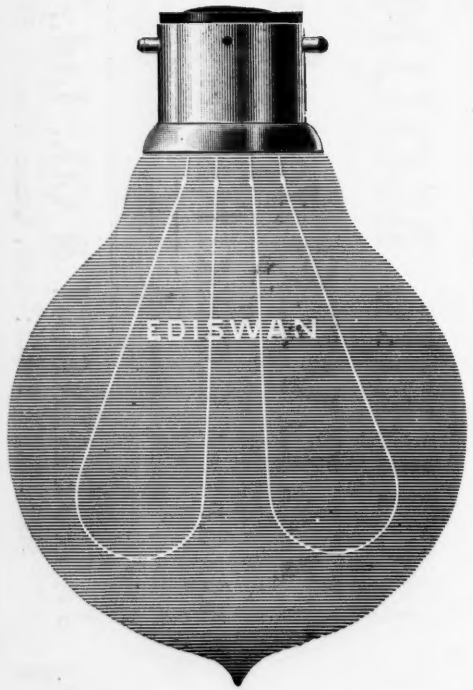

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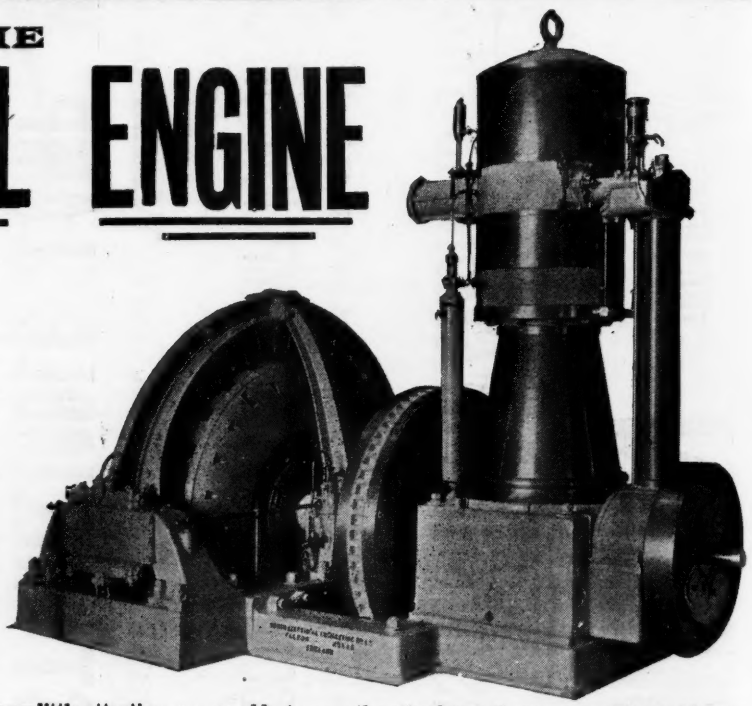

TESTIMONIAL.

WINDERMERE ELECTRICITY WORKS,
October 22nd, 1896.

To the Secretary,
Brush Electrical Engineering Company, Ltd, London.

DEAR SIR,

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(*Signed*) R. H. FELL & SONS, LIMITED.
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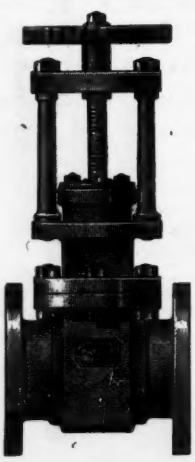

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